

4.0 FIELDWORK

The removal of OE from the Project Site will consist of a multi-step approach including mobilization and surface preparation, OE point clearance (geophysical and subsurface investigation), remediation of TNT-affected soils, areawide clearance, and grading to provide 14 feet of clean, crushed bedrock below final site grades in future residential areas.

This chapter provides the detailed field procedures required to complete OE remediation on the Project Site, as described in Chapters 2.0 and 3.0. The OE remediation (excluding areawide clearance) will require approximately 66 weeks. The preliminary site conceptual model will be revised based on the evaluation of the OE point clearance data to determine areas of the Project Site where areawide clearance is required. A schedule for areawide clearance will be developed following the evaluation. The proposed project schedule is provided in Appendix A. Soils will not be relocated to the North Valley until the non-OE remediation in the North Valley is completed, and the post remediation Human Health and Ecological Risk assessments are complete as shown on this schedule. Detailed field procedures are discussed in the following subsections.

- Site Safety, Public Outreach, and Security
- Mobilization/Demobilization
- Biological Survey
- Vegetation removal
- Removal and disposal of construction debris
- Relocation of stockpiles
- Removal and disposal of interior fencing
- Surveying and marking of grids
- Surface clearance
- Detection performance verification
- Detection and Mapping
- Intrusive investigations
- Disposal of OE and OE scrap
- Homogenization and disposal of TNT-affected soils
- Point clearance grading
- Areawide clearance grading
- Grading (cutting and filling to final grade)
- Environmental restoration.

4.1 SITE SAFETY, PUBLIC OUTREACH, AND SECURITY

4.1.1 Site Safety

Prior to the start of any OE field investigation activities, all field personnel will be required to read and sign the OE SSHP (Appendix F). Visitors will be required to attend a safety briefing, sign visitor logs, and be escorted on site. Site-specific training will be conducted for all personnel at the beginning of the

1 project and prior to commencing fieldwork. As new personnel arrive at the site,
2 they will be provided site-specific training prior to commencing fieldwork. A site
3 safety meeting will be held each morning in accordance with the guidance in the
4 OE SSHP. A HSO will be principally responsible for execution of all health and
5 safety operations for field activities. In addition, an OE SSO will be responsible
6 for execution of all OE operations for field activities. The HSO and SSO will
7 have the authority to stop work, when necessary, to prevent injury or illness
8 associated with the remedial actions and to ensure personnel and
9 environmental health and safety. The USACE Safety Specialist will monitor OE
10 field investigation activities to verify all operations are conducted in accordance
11 with the OE SSHP and this OE RDD. The USACE Safety Specialist has the
12 same stop work authority as the SSO.
13

14 Prior to the start of any OE surface clearance or excavations and intrusive OE
15 investigations, an MSD (200 feet for OE, 412 feet for TNT-impacted soil) will be
16 implemented and an MSA will be established for the community and remediation
17 personnel not directly involved with OE detection and removal activities. A
18 clearly marked security boundary around each designated MSA within the public
19 area bordering the Project Site will be established no later than 8:30 a.m. on the
20 day of the withdrawal.
21

22 A VSD will be established for all residents living within the maximum
23 fragmentation distance of the most probable munition (37mm HE projectile
24 [1,181 feet] or 60mm mortar, [1,080 feet]). Residents, businesses, and schools
25 within the VSD will be notified of the OE remediation activities that are taking
26 place on the Project Site and the risks associated with the work, as detailed in
27 the MSAP (Appendix B). All residents within the VSD wishing to withdraw will
28 be provided the same support as those residents living within the MSD.
29

30 Roads will be blocked using traffic barricades. Signs will be used to indicate
31 that entry is not permitted. Between road access points, the boundary will be
32 marked, as necessary, using yellow caution tape and signs. The marked
33 security boundary will be removed as quickly as possible after completion of the
34 intrusive work on the Project Site, but no later than 5:00 p.m.
35

36 **4.1.1.1 Procedures to Ensure All Affected Residents are Out of Their** 37 **Homes** 38

39 At the beginning of the withdrawal period, a walk-through of the entire MSA will
40 be conducted. A representative of the project staff will knock on each door to
41 assess if residents have withdrawn. Intrusive work on the Project Site will not
42 begin until the SSO is notified that the area is clear.
43

44 **4.1.1.2 Perimeter Control of Established Area by Security Personnel.** 45

46 Each access road will be manned by a qualified traffic control person.
47 Additional personnel will be used to provide 100-percent visibility around the
48 established perimeter.
49

4.1.1.3 Traffic Control Procedures.

Traffic control devices will be designed, installed, and maintained using the standards required by the City of Benicia, and the Manual of Uniform Traffic Control Devices. Applicable barricades, signs, lighting, markings, and hand signaling devices will be used for all traffic control on public streets.

4.1.1.4 Communication Procedures.

Radio contact will be maintained at all times during the period of time that the MSA is active. Positive radio contact will be verified at the beginning of the work between the Field Manager, Senior UXO Supervisor (SUXOS), SSO, USACE OE Safety Specialist, security personnel, and traffic control personnel. At a minimum, hourly radio checks will be made between these personnel during the period the MSA is active.

A public information telephone line will be established and maintained to provide updated information on project activities. The telephone line will also allow residents and businesses to express concerns or ask questions regarding project activities. Residents and businesses near the Project Site will be informed and notified to call the 24-hour information telephone line, rather than contact the police or fire department, in the event of a nonemergency, project-related question or concern. The point of contact for project activities is presented in Table 7-1.

In the event of an unintentional detonation, the emergency contingency plan in the OE SSHP would be followed. The public information telephone line would be updated to indicate that an unintentional detonation had occurred. The Occupational Safety and Health Administration (OSHA) and USACE personnel would conduct an evaluation of the incident, and the results of the investigation would be made available to the public on the 24-hour information telephone line.

Should an unintentional detonation result in any damage to a structure or other real property, all damage would be repaired; other private property damage would be repaired or replaced in kind.

4.1.2 Public Outreach

Notification of homeowners, schools, businesses, and supporting agencies concerning OE remediation activities will be initiated by the project proponents approximately 60 days prior to clearance activities. The project proponents will brief the Community Advisory Group, the City of Benicia, the Benicia Fire Department, and the Benicia Police Department approximately 30 days prior to commencement of intrusive or excavation activities. The briefing will include the anticipated dates of withdrawal for addresses falling within the MSA, and general withdrawal and relocation procedures.

Notices of the dates and times of the required withdrawal and relocation information ("Withdrawal and Relocation Notice") will be distributed

1 approximately 30 days, 10 days, and 72 hours in advance of the scheduled
2 withdrawal and relocation. On the evening before the planned withdrawal,
3 representatives for the project proponents will go door-to-door in the MSA to
4 remind residents about the next day's activities and to address any special
5 needs. It is anticipated that residents will be required to withdraw from their
6 homes from 8:30 a.m to 5:00 p.m. on the scheduled dates.

7
8 In addition, residents who live in areas outside the MSA whose homes are not
9 affected by the MSA, but whose ability to travel to and from their residences may
10 be impeded by the closure of streets within the MSA, and residents, schools,
11 and businesses outside an MSA, but within the distance that fragmentation
12 could conceivably travel in the event of an accidental detonation (VSD), will also
13 be notified of the potential hazards associated with clearance activities at
14 distances beyond the MSD.

15
16 If there are schedule or other changes between the 72-hour notification and the
17 date on which the OE clearance activities are to be performed, the residents will
18 be contacted and encouraged to contact the 24-hour information telephone line
19 or check the project website to make sure the planned withdrawal is on
20 schedule.

21
22 During the time that the withdrawal area is in effect, the Project Manager will
23 provide the required withdrawal distances, length of withdrawal time, and OE
24 work schedule to local City of Benicia safety officials, USACE, and DTSC.

25 26 **Relocation and Hospitality Services**

27
28 A Hospitality Center, which will be established for residents who are required to
29 withdraw, or who voluntarily withdraw from their homes during the day, will
30 provide refreshments and the use of telephones and other amenities. The
31 Hospitality Center will be established at the Best Western Heritage Inn at 1995
32 East Second Street in the City of Benicia (Figure 4-1). This location is close to
33 the residences and has sufficient conference room space for the number of
34 residents that are expected to utilize this facility. Directions to the Hospitality
35 Center and personnel to contact for additional information will be provided in a
36 newsletter that will be provided to residents within or affected by the MSA.

37
38 Transportation between the MSA and the Hospitality Center will be provided for
39 residents. Granite will have a representative available to coordinate all issues
40 related to the Hospitality Center. Granite will work closely with the school and
41 local residents to address issues related to the Hospitality Center during
42 fieldwork hours.

43
44 Special arrangements will be made for the transportation of handicapped
45 individuals.

46 47 **4.1.3 Project Security**

48

1 A fence has been installed to limit public access to the Project Site. The location
2 of the fence is shown on Figure 4-2. The main access point to the Project Site is
3 at the corner of McCall Drive on the western approach to Panorama Drive,
4 adjacent to the current manned guard shack. Two secondary access gates are
5 available. One access gate is across McAllister Drive where it crosses Rose
6 Drive. This gate is visible from the guard shack at the main access point. The
7 existing gate at the end of Kearney Street will also be used. The Kearney Street
8 gate will be used only by remediation personnel and will remain locked at all
9 times. Access to the North Valley may be gained through private property
10 bordering the Project Site on the east end of the North Valley. As necessary,
11 portions of the perimeter fencing will need to be removed to facilitate
12 geophysical mapping of the Project Site. Temporary fencing will be installed in
13 these areas, as necessary, to ensure that there are no breaches in the perimeter
14 fencing during OE remediation.
15

16 Signs have been attached at 200-foot intervals on the fencing along the north,
17 east, and south portions of the Project Site boundaries, except along the fence
18 on Rose Drive and Panorama Drive, where signs have been placed on stakes
19 behind the fence. These signs read "Keep Out, Former Military Property,
20 Hazardous Conditions May be Present" in English and Spanish. Signs have
21 also been placed every 100 feet along the perimeter fence contiguous with the
22 TNT Strips and along the fence around the TNT Strips. These signs read:
23 "Caution: Hazardous Substances Area, Unauthorized Persons Keep Out, Cal.
24 EPA, DTSC – (916) 255-3545" in English and Spanish.
25

26 Granite will continue to support a private security force to patrol the Project Site.
27 Patrol duties will include the following:
28

- 29 • Maintain a security force on site consisting of at least two patrol
30 officers between the hours of 5:00 p.m. and 7:00 a.m. One officer
31 will be posted at a guard shack near the public access point on
32 McAllister Drive; the other officer will roam the Project Site on
33 designated patrol routes.
34
- 35 • Maintain a logbook at the guard shack documenting the arrival and
36 departure times of all visitors to the Project Site, the purpose of their
37 visit, and the agencies or organizations they represent. A list of
38 preauthorized personnel allowed to enter the Project Site after hours
39 is kept at the guard shack.
40
- 41 • Inspection of all fencing and sign postings on site on a weekly basis
42 for breaches or disrepair. Any portions of the fence in need of repair
43 are noted and reported. Repairs or replacement of signs will be
44 facilitated within 2 working days after they are reported.
45

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2
3

- Patrol officers are required to carry radios and to check with each other at least once per hour. A telephone (cell or land-line) is maintained at the guard shack at all times. A copy of the OE SSHP

will be kept at the guard shack documenting procedures to be followed in case of an accident.

4.2 MOBILIZATION/DEMOBILIZATION

Mobilization of personnel to support field activities will be staggered based on fieldwork requirements. Table 4-1 illustrates the crew composition, number of crews for each task, and the anticipated production rate for each task. A Command Post will be established consisting of two temporary office trailers and one storage annex in the Unit D-1 area prior to mobilization. The management staff will consist of a Project Manager, SUXOS, UXO SSO, and Site Geophysicist. USACE, Sacramento District, will provide safety oversight for the project through an on-site OE safety specialist.

Air Monitoring Stations. Two PM_{10} air monitoring stations will be installed downwind of the site and one PM_{10} monitoring station will be installed upwind of the site to monitor PM_{10} from site excavations during certain OE remediation activities and during non-remediation (Figure 4-3). Air monitoring will be accomplished in accordance with the criteria specified in Section 3.2.1 during all site excavations in chemically affected soil areas and during OE detonations. Chemically affected soil areas include the Flare site; Demolition Sites #1 and #3; the TNT Strips; North Valley Stockpiles #1, #2, and #3; and may include the Unit D-1 Stockpile (If chemically affected).

4.3 VEGETATION REMOVAL

The Project Site will be cleared of vegetation to a height of 6 inches or less. Approximately 165 acres of the vegetation will be removed by mechanical means. Side-mounted mowers will be used to clear vegetation from a portion of the wetlands that is accessible to vehicle-supported equipment. The remaining 55 acres of the Project Site (including the jurisdictional wetlands) may be cleared by personnel using manual or hand-held gas-powered weed cutters equipped with spark suppression systems. The sequence in which vegetation will be cleared is shown on the Project Schedule (Appendix A). UXO personnel will proceed ahead of the vegetation clearance crews to search for OE items on the surface, both visually and with the aid of a site-tested metal detector, to assist visual reconnaissance in detecting OE items on the surface. If a surface OE is discovered during vegetation removal, the item will be clearly marked for avoidance and will be reported to the SUXOS and the Project Manager for recording, moving, and disposal. Surface OE will be disposed of using the procedures in Section 4.11.

Cuttings will be removed from the Project Site and transported to either Altamont Pass, Keller Canyon, or Potrero Hills landfill.

Brush-clearing supervisors will ensure that all team members have the appropriate safety equipment (i.e., work gloves, safety goggles, hearing protection) during vegetation removal activities in accordance with the requirements of the OE SSHP.

4.4 NONHAZARDOUS CONSTRUCTION DEBRIS AND STOCKPILES

All nonhazardous construction debris will be removed from stockpiles in Sectors 1 and 2 (Unit D-1), the Ridge (Sector 7), and the North Valley (Sector 8) (see Figure 2-2). Construction debris will be removed from these stockpiles concurrent with vegetation removal, interior fence removal, and survey and marking activities. Construction debris will be inspected by UXO Technicians to ensure that it is free of OE; nonhazardous construction debris will be loaded onto trucks and hauled off site to either the Alta landfill material recycler or the Altamont Pass, Keller Canyon, or Potrero Hills landfill. Construction debris will be removed from these stockpiles concurrent with vegetation clearance (shown on the Project Schedule [Appendix A]). Tarpaulins will be used to cover soils and debris being hauled off site to prevent fugitive dust, and soil stockpiles will be watered, as necessary, to prevent any dust from entering the air.

Soil stockpiles will be either removed or relocated during the course of the field efforts. Any OE discovered while handling the stockpiles will be identified as requiring a "BIP" or "safe to move" and will be disposed of, as discussed in Section 4.11.

Stockpiled soil in Unit D-1 and the North Valley will be geophysically scanned in a real-time EM scan and anomaly marking (magnetic and flag) mode using the MPA MTADS (see Section 4.9). Equipment operators will monitor both visual and audio output. The position of anomalous responses will be confirmed by returning and passing the instrument over suspect locations in at least two different directions to confirm the presence of a metal source. Stockpiles on the Ridge will be digitally mapped, the data processed, and identified anomalies reacquired and marked.

Following each pass over the stockpiled material, the anomaly locations will be intrusively explored and the anomaly sources removed and disposed of in accordance with the requirements of Sections 4.10 and 4.11.

4.4.1 Unit D-1 Debris Stockpile

It is not anticipated that an MSD will be implemented for the removal of construction debris from these stockpiles. However, UXO Technicians will inspect the debris for OE and explosives as it is being removed. After removal of the construction debris from the stockpile in Sectors 1 and 2 (Unit D-1), the soil will be sampled and analytical testing will be performed to assess the soil quality. An MSD (Figure 4-4) will be established before the soil is relocated. If chemical concentrations in the soil exceed cleanup goals, the piles will be spread out. The soil layers will be scanned and anomalies, if any, will be removed (see Section 4.10). Any OE discovered will be identified as requiring a BIP or safe to move and disposed of as discussed in Section 4.11. A QC scan will be performed and the soil will be excavated in lifts 6 inches less than the reliable scan depth, loaded into trucks, and disposed off site at a suitable landfill. Once soils are removed, the underlying material will be sampled in accordance with the non-OE RDD to determine if the underlying material has been

1 chemically impacted. If samples determine that the underlying material is
2 impacted, the process of scanning, excavating, and sampling will continue until
3 all chemically impacted material has been removed. If chemical concentrations
4 do not exceed cleanup goals, the soil will be leveled within the boundary of
5 Sector 2. The leveled stockpile will be geophysically scanned, point cleared,
6 and hauled off-site to a landfill or temporarily relocated to Sector 10 as part of
7 the detection and mapping of Sector 2. The Project Schedule (Appendix A)
8 assumes that the stockpiled soils do not exceed cleanup goals.
9

10 **4.4.2 North Valley Stockpiles #1, #2, and #3**

11
12 Because the construction debris in Stockpiles 1, 2, and 3 in the North Valley is
13 commingled with soils, these soil and debris piles will be excavated and spread
14 to remove the debris. Stockpiles 1 and 2 will be spread in a southerly direction
15 and Stockpile 3 will be spread in a northeastern direction. An MSD will be
16 established for the grading of the stockpile and for any intrusive activities
17 (Figure 4-5). The construction debris will be separated from the soil as each
18 stockpile is being spread, inspected to determine that it is free of OE, loaded
19 onto trucks, and hauled off site to either Altamont Pass, Keller Canyon, or
20 Potrero Hills landfill.
21

22 After the construction debris is removed, the remaining soil will be geophysically
23 scanned, as described above. Any anomalies found during the scanning will be
24 intrusively explored and the anomaly sources removed and disposed of in
25 accordance with the requirements of Sections 4.10 and 4.11. A QC scan will be
26 performed over the spread soil and a lift of soil will be excavated, loaded onto
27 trucks, and hauled off site to a suitable landfill. The soil stockpiles will again be
28 scanned, any anomalies will be removed, QC scanned, and a lift excavated.
29 The soil will be hauled to a suitable off-site landfill. This process will be
30 continued until all of the stockpiled soil in the North Valley has been disposed of
31 off site. The Project Schedule (Appendix A) assumes that the stockpiled soils
32 can be removed in three lifts.
33

34 **4.4.3 Ridge Stockpiles #1 thru #9**

35 Because no OE is associated with the construction debris, an MSD will not be
36 implemented for its removal from these stockpiles. After removal of the
37 construction debris from the stockpiles in Sector 7, an MSD will be established
38 and the nine stockpiles will be spread out in Sector 7 (Figure 4-6). The soil will
39 be geophysically scanned, as described above. Any OE discovered will be
40 identified as requiring a BIP or safe to move and disposed of as discussed in
41 Section 4.11. The cleared lift will be QC scanned, removed, and either disposed
42 of off site or re-stockpiled in Sector 10A or 10B. The soil will again be scanned
43 and any anomalies will be removed. The lift will be QC scanned and a second
44 lift (nominally 1 foot thick) will be removed. This process will be continued until
45 all of the stockpiled soil on the Ridge has been scanned and cleared of OE or
46 OE scrap. The Project Schedule (Appendix A) assumes that the stockpiled soils
47 can be removed in three lifts.
48

4.5 INTERIOR FENCE REMOVAL AND DISPOSAL

Interior fencing that is not providing security on the outer boundary of the site will be removed and disposed to facilitate unobstructed access to all sectors on the site (Figure 4-7). Outer or boundary fencing will be temporarily removed and re-installed, as necessary, to allow geophysical mapping crews to map the boundaries without magnetic interference from the fencing. Non-metallic, temporary construction fencing may be used during the geophysical surveys. Fence removal and re-installation crews will be escorted by a qualified UXO Technician using OE avoidance techniques outlined in the OE SSHP. Any OE discovered on the ground surface will be identified as requiring a BIP or safe to move and disposed of, as discussed in Section 4.11. Interior fencing is scheduled to be removed concurrent with vegetation clearance (Appendix A).

4.6 SURVEY AND MAPPING

Surveyors will install semipermanent markers (36-inch survey stakes) in lines at 100-foot intervals across the property until the entire search area is covered with a 100-foot by 100-foot grid mesh (Figure 4-8). A combination of Differential Global Positioning System (DGPS) and Total Station surveying equipment will be used to locate and install semipermanent markers throughout the Project Site. Survey and mapping of the Project Site will follow vegetation clearance tasks (Appendix A).

UXO personnel will escort the surveyors during this task using OE avoidance techniques. The escorts will visually check the surface and scan the locations (using a site-tested metal detector) where the stakes will be driven for monuments. Locations coincident with anomalies will be avoided by setting witness stakes 36 inches from the monumented location. OE encountered during visual sweeps will be marked and reported to the SUXOS and the Project Manager for recording and disposal.

Survey stakes will be wood and will be painted with a nontoxic, fluorescent orange paint to provide easy visual location. The southwest corner stake for each grid will be embossed with a discrete identifying number. Alpha characters will denote grid position progressing alphabetically west to east while a sequential numeric code will identify the northing reference for the grid (from south to north). The origin for the survey grid will be set at a point in Sector 1 at 1,791,000 north and 6,518,900 east (CSP grid). Once the grids are constructed, maps will be developed illustrating grid location for use in operation planning and team assignments. All field books, sketches, and computation sheets will be maintained in the project documentation files. Surveying and mapping products will be required in English units.

Control points will be identified on the map by name and number and the final adjusted coordinates and elevations (to the closest foot). Each map will include a grid north, a true north, and a magnetic north arrow, with the differences between them in minutes and seconds shown. Grid lines or tic marks at systematic intervals with their grid values will be shown on the edges of the

map. A legend showing the standard symbols used for the mapping and a map index showing the Project Site in relationship to all other sites within the boundary lines of the project area will be shown.

The original copies of all field books, layout sheets, computation sheets, abstracts, and computer printouts will be suitably bound and clearly identified. A tabulated list of all control points (e.g., monuments, aerial targets, corners) showing the adjusted coordinates and elevations (in meters and feet) established and/or used for this survey will be developed and maintained.

4.7 ORDNANCE AND EXPLOSIVES SURFACE CLEARANCE

UXO crews will use visual search methods aided by site-tested, hand-held metal detectors to clear each grid of any surface OE, OE scrap, or metallic debris. Surface surveys will be conducted using an OE surface clearance walking sweepline within each grid. Sweep personnel will start from the western grid boundary and systematically sweep the area using a 5-foot separation distance between each sweeper visually inspecting the ground 2.5 feet to either side of each individual (Figure 4-9). All sweepline personnel will be provided with either a Geonics EM61-HH or White Pulse Induction SurfMaster hand-held, all-metals detector. The actual equipment will be determined during equipment performance verification testing. Each sweep team will also be provided with a differentially corrected GPS unit. The GPS position will be recorded for all discovered OE. Surface clearance will be completed after the 100 foot by 100 foot grids are established beginning with those grids within 200 feet of the project boundary (see Figure 4-8) followed by each sector, as shown on the Project Schedule (Appendix A).

Surface clearance of the wetlands will be accomplished only in the east (narrower) portion of the South Valley wetlands. The west (broader) portion of the South Valley wetlands will not be surface cleared. In order to surface clear the east portion, the area must be dewatered. This will be accomplished through use of temporary dams with the water being pumped around the area to be surface cleared. The west portion will not be surface cleared prior to geophysical mapping, because the instruments will be floated across the wetland; therefore, the ground need not be disturbed.

The hand-held all-metals detector will be used as an aid in locating surface debris and the GPS unit will be used for marking the surface location of OE during the surface clearance. OE scrap encountered during the surface search will be reported to the SUXOS and recorded on the OE Surface Clearance Information Sheet (Appendix H). OE items will be flagged for disposal operations. All OE, recognizable OE scrap, and metallic debris that could impact subsurface detection and mapping of potential OE sources will be removed. OE scrap will be piled at the southwest corner of each grid. OE and OE scrap will be processed in accordance with the Surface and Geophysical Source Process flowchart (Figure 4-10), which is further described in Sections 4.10.4, 4.10.5, and 4.11. Recorded data will comprise the DGPS track of the

sweep team and the characteristics and DGPS location of any discovered OE or recognizable OE scrap.

An OE disposal operations team will remove all OE scrap and metallic materials from the southwest corner of the grids. Disposal operations teams will also remove all "safe to move" items that have been flagged by the surface clearance teams. All OE items that are determined unsafe to move, as determined by the SUXOS, SSO, and USACE Safety Specialist in accordance with procedures detailed in Section 4.10.5, will be BIP.

OE disposal operations will be conducted in accordance with Appendices I and J and as described in Section 4.11. All OE scrap and metallic surface debris will be transported to a designated on-site holding area where it will be recorded, certified as inert, segregated, and stored in secure roll-offs or steel drums with locking tops awaiting final disposal to a scrap metal recycler.

A random visual surface clearance QC inspection will be performed over 10 percent of each grid. The 10-percent QC inspections will be conducted by the field investigation QC staff (see Section 6.2.4.1) prior to allowing unescorted personnel access to the grid. Any grids that fail the QC inspection will require another complete surface clearance if OE or OE-like items are found. QC results will be tracked with special attention for recurring QC failures that might be indicative of systemic problems. Each grid QC failure will be jointly reviewed by the Project Manager, SUXOS, QC Specialist, and the team supervisor to identify and correct root cause(s) of the failure.

4.8 DETECTION PERFORMANCE VERIFICATION

An equipment performance verification test plot (Figure 4.11) will be used to (1) determine the operational limitations of the selected geophysical methods to be used at the Project Site, and (2) define the remedial design depth criteria. The test plot will be used to verify the performance of all geophysical systems deployed to the Project Site. Equipment performance verification will be accomplished as shown in the Project Schedule (Appendix A). Multiple inert OE targets will be laid out at differing depths. The plot will document the reliable depth of detection for the most probable munition (37mm HE projectile); the design criteria are based on the performance limits of the instrumentation. The detection performance verification includes the following steps:

1. Assemble/check out equipment
2. Establish positional survey control point using Optical Total Station Survey System
3. Set corners of the verification plot using Optical Total Station Survey System
4. Perform OE surface clearance over verification plot

- 45 5. Collect geophysical background data with each deployed system (data
to be collected in two orthogonal directions)
- 46 6. Construct Test Plot:
- Excavate pot holes
 - Set inert OE targets
 - Measure depth to top of each target (below ground surface)
 - Measure position of each target (in relative grid space coordinates)
 - Survey position of each target in CSP using optical Total Station
 - Bury targets and reclaim ground surface to as near as practical the pre-excavation conditions
- 47 7. Collect Geophysical Target Response Data with Each Deployed
System (data to be collected in two orthogonal directions)
- 48 8. Repeat Step 7, twice
- 49 9. Process digital geophysical data and identify anomalies of interest
- 50 10. Survey test plot in real-time with each system and system operator,
flag anomaly locations, survey in anomaly locations with Total Station
- 51 11. Repeat Step 9, twice
- 52 12. Recover anomaly locations using RTK GPS survey instrument
- 53 13. Evaluate detection performance
- 54 14. Geophysical Equipment Performance Verification Report.
- 55
- 56 The plot nominally comprises multiple parallel transects in a 2.0-acre (250 feet
57 by 350 feet) area. The separation between targets and the depths of burial will
58 be as detailed in the following subsections. The test plot will be removed at
59 completion of the sitewide removal action. The test plot will be large enough to
60 accommodate inclusion of targets seeded by USACE in locations not known to
61 either the geophysical subcontractor or the project personnel. This is intended
62 to provide an additional QC check of the target discrimination capabilities of the
63 technology and methodology employed at the Project Site and may be
64 performed at their discretion.
- 65
- 66 MTADS, MPA MTADS, and hand-held EM instruments (Geonics EM61-HH and
67 White Pulse Induction SurfMaster) will be deployed to determine performance

limits from multiple passes over the test bed for each specific system used. The data will be collected in continuous traverses (no stopping and searching) along the designated paths, and spatially referenced via either RTK or DGPS data. The geophysical survey team(s) will have no prior information regarding target location, orientation, depth, or OE type.

EVALUATION PLOT DESIGN AND DEVELOPMENT

An accessible 2-acre evaluation plot will be identified for the equipment test site. Ideally, the location will not be in an area of OE concern. However, if the test plot is located within an OE area, all intrusive requirements, as specified in the OE SSHP will be observed. The selected plot will be representative of the vegetation and geology/soils to be encountered within the areas to be remediated during the field activities. The terrain of the evaluation plot be representative of the median relief of the Project Site.

The remediation contractor will seed the area with inert ordnance and ordnance scrap set in the evaluation plot as near as possible to the relative locations provided by this design. Test items will be buried such that three sets of three like targets will be set at three mutually orthogonal orientations, with additional like targets set both above and below the triplet depth. Targets are buried at shallower and deeper depths than the calculated maximum depth of detection to challenge the detection capabilities of the geophysical equipment. Burial depths were determined using the maximum detection depth criteria for each target item of concern at the Project Site. Seeded target locations will be deviated only to avoid subsurface anomalies already there and disturbance of animal burrows or established plant root systems. The geophysical equipment evaluation plot target inventory is given in Table 4-2. The evaluation plot design is presented as Figure 4-12.

Evaluation Plot Location. Survey control establishing the corners of the evaluation plot will be established in NAD83 CSP coordinates, California, United States survey feet. The corners of the investigative grid will be located in the field to the closest tenth of a foot and marked with an 18- to 24-inch iron pipe or rebar driven into the ground with a 2- to 6-inch stick-up aboveground and witness stakes offset 3 feet from the plot corner. The aboveground stick-up will be painted with a high-visibility orange or pink paint and capped with protective plastic covers. These established corners will be used as the basis for documenting seeded item locations.

Background Characterization. Prior to seeding the targets, background data will be collected using electromagnetic methods. The data will be digitally recorded and processed to produce geophysical isogram contour plots that identify the background characteristics of the evaluation plot.

EXCAVATION AND SURVEY

Vegetation will be removed from the test plot and a surface OE clearance will be performed prior to collecting background data and planting the targets. All seeded items will be situated to the closest tenth of a foot with their CSP coordinates tabulated on the drawings and entered on a Microsoft Excel spreadsheet. Each seeded target will be painted with a high-visibility paint, tagged, identified, and inventoried. Excavations for the targets will be made by hand shovel and power auger. The target locations will be surveyed and tied to the corners of the evaluation plot in CSP coordinates. Surveyed locations will be accurate to 0.1 foot. Target pits will be backfilled and the ground surface compacted and restored to as near pre-excavation conditions as is reasonably practical, including replacement of original topsoil with attached vegetation.

AS-BUILT DESIGN

The remediation contractor will apply the design as a template to the chosen evaluation plot sites and will then provide an as-built design of the evaluation plot site after the targets are emplaced. The as-built will consist of a base map that shows the plot and lane boundaries and any planimetric features such as roads, buildings and fences with CSP coordinates tick marks and a sheet border and title. Seeded items will be shown with a standard symbol and unique identifier code referenced to a table in the file that shows the item description, depth, coordinates, and any other descriptive information. The table will be placed so that the two files can be plotted to create an as-built composite.

GEOPHYSICAL EQUIPMENT EVALUATION

EM instrumentation, comprising the MTADS, MPA MTADS, and hand-held Geonics EM61-HH and White Pulse Induction SurfMaster metal detectors will be evaluated. Magnetometer systems have been excluded from consideration because the Project Site, like all demolition sites, possesses the potential to contain a significant population of nonferrous OE that cannot be detected with magnetometry systems. However, to demonstrate the relative performance of the EM versus a magnetometer system, magnetometry data will be collected over the test plot.

Man-portable and vehicle-towed platform arrays will be deployed. Data will be digitally recorded coincident with CSP coordinates utilizing differential or RTK GPS. The geophysical survey team will continuously track and monitor the position of the instrumentation within the evaluation grid to assure complete coverage with the systems deployed. Data will be collected over the test grid along contiguous survey lanes. The Standard Operating Procedures for equipment operation, functional checks, data capture, processing, and interpretation are presented in Appendix K.

During the equipment evaluation, the navigational accuracy of the positional reference instrumentation (DGPS or RTK GPS) will be tested to identify and quantify temporal and spatial shifts in the data. Prior to commencement of the

project, satellite coverage shall be determined for the proposed workday. Period(s) of insufficient satellite coverage shall be identified and integrated into schedule planning.

Digital data will be downloaded to an IBM-compatible PC. EM data will be formatted in x, y, and z ASCII files with the survey values coincident with coordinate locations. A time stamp for the data will be included to assist with evaluating time lags/shifts that may need to be corrected in post-processing.

PERFORMANCE OBJECTIVES

Detection Performance

- The equipment test plot data will be used to generate site-specific detection performance curves. The curves will be used to determine the reliable depth at which the MPM (37mm) will be detected bgs.
- Horizontal Accuracy: 90 percent of all identified anomaly locations must lie within a 1.65-foot radius of their actual location as shown on the "dig-sheet," and 98 percent of all anomaly locations must lie within a 1.3-foot radius circle of the reacquired surface location.

Locational Accuracy. The tolerances for locational accuracy will be identified by comparing the known grid position of targets (± 0.1 foot) to the location given by RTK GPS. Geophysical data will be collected coincident with CSP coordinate data with an RTK GPS capable of 8 inches precision; the apparent target (anomaly) location derived from data processing will also be compared to known target position. Lastly, reacquisition of anomaly locations will be compared to grid location of the targets. Locational accuracy error will then be the sum of individual positional errors.

Geophysical Instrument Precision. Instrument standardization responses will vary by no more than ± 10 percent of the standard response for each fielded system. The standard response will be determined by placing a 3-inch carbon steel sphere in a fixed geometry with the instrument sensor receiver and comparing the target response to background response at the same location. The sphere provides a reference target that can be used at any location at the Project Site. Static background readings will be recorded for a minimum of 30 seconds (at a 1 hertz [Hz] sampling rate). The standard target will then be introduced and target data records recorded for 30 seconds (again at 1Hz). The residual, or mathematical difference between the target and background response will be the standard response. A mean deviation from the standard response will be calculated from multiple tests (minimum of three) for each instrument used.

Survey Completeness. Tolerances for completeness will be evaluated by determining the percentage of data drop-outs, unusable, or missed data along any single pass that can be allowed without compromising the identification of

target anomalies. Coincident GPS coordinate and geophysical data will be used to generate a plot of track coverage that will be compared with a theoretical track and anomaly response profile. The initial criterion will be capture of at least 98 percent of the possible data points along a given transect; 100 percent of the area must have been covered after the second, orthogonal survey.

Representativeness. The target sources and anomaly parameters (signal amplitude and width; target shape, depth and orientation) will be evaluated to determine an acceptable range of representative responses for each target.

Anomaly Recovery. Anomaly location reacquisition will be evaluated by navigating to the coordinate of the anomaly with RTK GPS equipment. After the anomaly positions, as identified through computer processing of the geophysical data, have been recovered in the field, an MPA-MTADS will be used to re-define the apparent anomaly centroid and dimensions. Offset distances between the recovered and actual locations will be measured and recorded. Survey tolerances for anomaly recovery and investigation will be extrapolated from these data. If the hand-held instrumentation cannot resolve the identified anomaly (e.g., target is too deep), the CSP coordinates will be taken as the target location.

SENSOR SURVEY GEOMETRY

The configurations and measurement geometrics to be used for the deployed systems will be determined during the equipment evaluation. The equipment will be comprised of components that can be used as an individual system and ganged arrays of multiple detectors. All mapping instruments will have the means of electronically capturing both geophysical response and coincidence measurement locations in a data logger for subsequent processing and analysis. The sensor separation for EM focusing coils will be as specified by the instrument manufacturer. Sensor heights will be optimized to allow as small as possible a standoff height, as dictated by existing terrain and ground surface conditions.

DATA COLLECTION

MTADS EM data are to be obtained using standard operating procedures established by the subcontractor (Appendix K). Geophysical data will be collected at no greater than 2.5-foot transect spacings (5-foot for ganged arrays) and measurements made initially at no greater than 0.5-foot station intervals. Potential peak amplitudes will be estimated prior to mapping the evaluation grid by evaluating instrument response over ground surface targets and extrapolating response curve fall-off with depth. Survey speed will be such that the instrument response reaches 90 percent of the potential peak amplitude.

Three sets of data will be obtained for each deployed geophysical system. The data sets for each system will comprise responses from two orthogonal surveys of the test plot.

DATA EDITING AND FORMATTING

The field data will be checked, corrected, and processed into ASCII files in an ADF file format. All edits and corrections made will be fully documented. Any temporal or spatial shifts between geophysical detection and navigation systems will be quantified and documented. Time/space corrections will be developed as needed. The data will be presented in delineated fields as x, y, and z, where x and y are CSP coordinates in east and north, and z is the instrument reading. Where multiple instrument values are recorded, each channel of the data will be presented as x, y, z_1 , and z_2 , where z_1 is the value of the top sensor and z_2 is the value of the bottom, collocated, and simultaneously collected sensor. Each field of data, including time stamps, will be recorded in separate columns within the data files. A copy of all digital and electronic data will be appended to the geophysical equipment evaluation report for technical review and evaluation by USACE.

DATA TRANSFER

Data will be digitally recorded and delivered in a format suitable for transmission via telephone modem or other electronic telecommunications media. The procedures and routines for accomplishing this task will be developed and implemented interactively during the equipment evaluations. Data will be processed in the field and the OE contractor will post the processed data to a public web site within 2 working days of completion of the evaluation grid survey. An archive PC-CD ROM containing all field data will be delivered to USACE within 2 days of completion of the field test effort.

DELIVERABLES

- Digital data for EM survey results, as above, in IBM-compatible ASCII x, y, and z format. Data will include preliminary processed (straight conversion to ASCII) and final processed (time or distance lag, position corrected) data and will include digital PDF versions of the hardcopy maps. Each ASCII file will have headers for each column of data.
- Hard-copy, filled color geophysical image plots of EM response (one for each channel collected).
- Individual survey lane data profiles plotting response amplitude versus distance (one for each channel of data collected).

EQUIPMENT LIMITATIONS/REMEDIAL DESIGN CRITERIA

The performance of the geophysical system responses will be scored on seeded targets detected. Allowable tolerances for positional accuracy for the geophysical investigation will be extrapolated from the evaluation plot survey, geophysical anomaly maps, and target location maps to be provided through the above tasks.

The geophysical equipment evaluation will test the geophysical instruments and techniques, as well as the methodology of transferring and processing data among the team members. Data will be assembled and formatted in the field to meet the geophysical survey data requirements.

Performance Criteria. Achievable (reliable) depth of detection for each type of geophysical system deployed will be determined from the equipment performance verification test plot, geophysical anomaly profiles, and target location maps to be provided through the previously outlined tasks. The minimum detection depth (e.g., that depth at which each system detected all inert 37mm HE projectiles buried in the test plot) will be taken as the reliable detection depth for that type of equipment. This detection depth will be the design criteria for the remedial action.

Horizontal Accuracy. Only those identified anomalies that are within a 1.65-foot radius of the actual target location, as shown on an as-built diagram, will be considered in the determination of the reliable depth of detection for the selected instrumentation.

Performance Verification. The established, reliable depth detection and the overall quality of the subsurface detection and mapping effort will be verified at a field test site (Sector 10B), in accordance with the process flow detailed in Figure 4-13.

REAL-TIME SURVEYS

MPA MTADS equipment operators will survey the test plot in a real-time mode, visually and audibly discriminating anomaly locations. Each system will be tested using multiple passes (more than two) over the test plot. Real-time data records consist of "picked" anomaly locations. To keep results as unbiased as possible, no semipermanent or permanent marks will be used to identify the "picked" positions. The QA/QC derives from the comparison of "flagged" location versus actual position. The operators will mark the locations of these anomalies by passing the MPA MTADS over the suspect position in at least two different directions.

The identified target locations will be landmarked with a differentially (post-processed or RTK) corrected GPS survey system. These target locations will be evaluated to determine the detection depth tolerances for real-time survey operations. The depth for reliable detection of the MPM will be greatest at the depth at which every operator correctly locates the targets.

GEOPHYSICAL EQUIPMENT EVALUATION REPORT

A geophysical equipment evaluation report will be prepared by the project geophysicists following the conclusion of the data collection. The result of this evaluation will be a determination of the reliable depth of detection for the systems tested, positional resolution tolerances, and an estimate of the maximum detection depths for digitally collected data. The report will be

submitted to DTSC, USACE, Granite, and the City of Benicia. The report will document all activities performed to create the test plot and establish the criteria for the geophysical survey and quality control applications. It will contain all digital data from the investigations and analysis. Once the design criteria are established, the balance of the site can be remediated. The schedule for these activities is presented in the Project Schedule (Appendix A).

4.9 DETECTION AND MAPPING

Geophysical data will be collected and analyzed to identify locations of subsurface anomalies. Geophysical team(s) will perform continuous tracking, checks, and adjustments of the field data for QC and to establish efficient field procedures. Navigation and instrument position will be tracked and recorded using state-of-the-art RTK DGPS instrumentation. The CSP grid coordinate system will be used and referenced to the National Geodetic Survey NAD83.

The entire surface area (approximately 220 acres) of the Project Site will be geophysically mapped using an MTADS or MPA MTADS. The detailed mapping sequence for each sector is shown on the Project Schedule (Appendix A). EM data will be collected at 10 Hz and correlated with the navigation data. Survey speed will be constrained to ensure measurements are recorded at no more than 1-foot intervals along the survey lanes. The sensor measurements will be mapped out separately for each of the upper and lower coils. Offsets are to be automatically subtracted from each array to correct for a direct current (DC) bias.

The MTADS will use a Trimble 7400 DGPS for positioning. The system will be operated in RTK, On-The-Fly mode, which provides a 2-inch level of accuracy with 5-Hz updates. The DGPS satellite clock time will be used to time-stamp both position and sensor data information for later correlation. Position dilution of precision calculations will be provided as part of the data stream.

A data acquisition (DAQ) computer will be used to provide real-time guidance displays and information for the driver. Perimeter surveys or point landmarks will be used to define the survey bounds. The maximum tow speed of the MTADS with EM sensors is expected to be 2-3 mph. Limits for station intervals along each transect (function of traverse speed), as well as transect spacings, will be determined during the equipment performance verification tests. Given limitations imposed by terrain, vegetation, and vehicle/MTADS operating requirements, actual survey traverse speed is expected to be 2 mph. Taking into consideration the time to conduct daily operations and safety briefings, equipment standardization tests (before and after surveying, and hourly), mobilizing equipment and crew to the survey line, periods of low satellite coverage for DGPS, downloading data, and conducting daily maintenance, daily productivity for the Tourtelot Project is expected to average 6-8 acres per day per vehicle-towed MTADS.

Where the MTADS cannot be deployed, either because of terrain steepness, vegetation, or other obstacles to coverage with the trailered array, an MPA

1 MTADS instrument will be used. These systems may require some means of
2 belaying the instruments (and operators) as they traverse the steeper terrain,
3 flotation supports, or other site-specific deployment requirements. The actual
4 mechanics and logistics for use of the alternative instruments will be resolved in
5 the field, as specific obstacles and/or problems are encountered. Survey
6 productivity with the MPA MTADS is expected to average 2 acres per day per
7 system deployed.
8

9 Geophysical survey setup, data acquisition, and data processing will be carefully
10 controlled to obtain complete, precise, representative, and repeatable data. The
11 processes to be used to obtain high-quality data are outlined below. Appendix K
12 presents the Standard Operating Procedures and QC protocols to be
13 implemented by the geophysical field services subcontractor. These provide a
14 detailed discussion of the data acquisition and processing procedures and steps
15 to be followed. The QC protocols will be specific to the Tourtelot project and will
16 be provided to DTSC and USACE prior to mobilization of subcontractor
17 personnel and equipment.
18

19 Complete survey coverage will be obtained by ensuring overlapping of the
20 MTADS (and MPA MTADS) footprint through control of line spacings. Survey
21 precision will be controlled by requiring replication of a standard geophysical
22 response. GPS positional data will also meet a specified tolerance for
23 replication of position over fixed, known points at the Project Site.
24 The characteristics of anomalies identified during data processing will be
25 compared to the discovered sources to verify that the source is representative of
26 the anomaly. Data processing to identify the anomalies must be quantifiable
27 and repeatable, and to include:
28

- 29 • Evaluation of QC standard tests
- 30
- 31 • Evaluation of lag correction
- 32
- 33 • Evaluation of field notes for cultural features
- 34
- 35 • Evaluation of sensor data for spikes, gaps, and sensor failure
- 36
- 37 • Editing or removal of low quality positional data points
- 38
- 39 • Evaluation of coverage (i.e., data gaps)
- 40
- 41 • Application of demedian filter to remove sensor drift and level the
- 42 data to a zero baseline (a 1,000-point average is used for EM data
- 43 and a 400-point average is used for Mag data).
- 44

45 Following the preprocessing phase, the data analysis will include:

- 46
- 47 • Plotting the sensor data in gridded and pixel format
- 48
- 49 • Applying filters to the gridded data (when necessary) to aid in target
- 50 identification

- Selecting targets utilizing a peak-picking algorithm
- Identifying additional targets that were not selected using the peak-picker
- Reviewing data and removing targets attributed to edge effects and cultural features
- Preliminary modeling to produce estimated size and depth for identified targets
- Generating an output of the final data in XYZ ASCII format
- Plotting a hardcopy map of the data with target locations superimposed
- Producing a final target sheet with location, peak value, estimated size, and estimated depth.

Field data check forms and the specific data processing routines are to be found in the MTADS Standard Operating Procedures (Appendix K).

The wetlands areas will be divided into sections for OE point clearance operations. In areas where the wetlands are narrower (e.g., the eastern part of the valley), temporary wooden structures may be placed across the wetlands area to allow the geophysical crew to use the vehicle-towed MTADS to locate anomalies within the wetlands. The MTADS array will be towed by a small, track-mounted vehicle. In the wider areas of the wetlands (e.g., the western part of the valley) where access by the vehicle-towed MTADS could be problematic, an MPA MTADS (man-towed or raft-mounted) will be used.

In areas of the wetlands where the MPA MTADS will be floated, an in situ test of the MPA MTADS detection capabilities will be conducted.

Table 4-3 summarizes how the geophysical equipment will be used on the Project Site.

4.9.1 Geophysical Data Collection and Data Processing

4.9.1.1 Data Collection.

Each geophysical survey team will consist of an instrument operator and a field assistant to aid in tracking control. Geophysical data will be digitally captured into a file with coordinates recorded relative to the CSP grid coordinate system. A field logbook will be maintained that details pertinent activities, survey lane features, and field conditions encountered in the performance of the geophysical characterization. A field sketch map of mapped survey lanes will be made as or before the geophysical data collection progresses/commences. All activities related to geophysical data collection will be documented in the daily field

1 logbook. Field maps will note date/time of the survey, area covered, and the
2 location and description of noise sources that will affect interpretations.

3
4 A safety and work assignment briefing will be conducted prior to the beginning
5 of each day's field activities. The safety briefing will address any known hazards
6 of concern for the particular area(s) to be investigated. Attendees and briefing
7 substance will be recorded in the field logbook. Elements of a survey day
8 include:

- 9
- 10 • Morning pre-survey checks of instrument and batteries
- 11
- 12 • Safety and planning briefing
- 13
- 14 • Identification of traverse segment(s) to be mapped
- 15
- 16 • Equipment set-up
- 17
- 18 • Initialization of data logger(s) to record geophysical response
- 19
- 20 • Performance of instrument standardization
- 21
- 22 • Traverse of survey lanes to collect data; verification of complete
- 23 investigation of all segments.
- 24

25 The geophysical survey team will continuously track and monitor the position of
26 the instrumentation array during data collection to assure complete coverage of
27 the areas of interest. This will be accomplished through the use of lane
28 markings and by maintaining alignment of the instrument array relative to
29 transect waypoints.

30
31 At the completion of each survey day, field notes, maps, standardization
32 documentation, and digital survey data will be delivered to the remediation
33 contractor's Project Manager on 3.5-inch, IBM-compatible microcomputer
34 diskettes in ASCII format. The diskettes will be labeled with survey lane
35 identifications and date. A copy of the disk will be forwarded to DTSC and
36 USACE, Sacramento District, within 5 days.

37 38 **4.9.1.2 Standardization.**

39
40 Proper operation and function of the instruments used will be checked and
41 documented in the field log each day by a standardization process prior to the
42 day's geophysical surveys. The first day on site for geophysical personnel
43 (other than for project orientation) will be used to establish baseline responses
44 over the equipment test plot and standardization acceptance ranges for each
45 mapping system deployed.

46
47 Standardization procedures and standard response (for each system) will be
48 established before any geophysical mapping of the survey lanes is performed.
49 This will be accomplished by establishing a target and a background reference

1 geometry and determining the numerical difference between target-anomaly
2 high and background response of each system. Multiple anomaly-versus-
3 background measurements will be made to allow computation of a mean
4 residual (anomaly response) and calculation of a standard deviation specific to
5 the system.
6

7 Standardization of each system will be performed periodically each day to
8 ensure proper operation and function of the system, including before any
9 mapping activity and prior to shutting down the equipment for any reason.
10 Standardization will be accomplished using a portable source in a fixed, ground-
11 level geometry with each receiver antenna. The portable source is used to
12 eliminate the need to return to one location several times each day. The
13 portable standard target will be a solid, 3-inch-diameter carbon steel sphere.
14 Standardization consists of comparing the residual anomaly to the acceptance
15 range and recording the values in the daily logs. Acceptance range is specified
16 at ± 10 percent of the standard response (calculated mean residual anomaly).
17

18 The geophysical equipment positional accuracy will be monitored daily to ensure
19 that chosen tolerances are maintained. Metal stakes will be placed in the
20 ground and their location measured using DGPS. Each piece of geophysical
21 equipment will measure two of these stakes daily. The offset between the
22 measured anomaly location and the known location of the stakes will be
23 recorded in the daily logs and will not exceed the established tolerances.
24

25 The standardization response and acceptance range will be recorded in the field
26 logbooks assigned to each arrayed antenna component receiver. If a system
27 component does not respond within the acceptance range, the standardization
28 measurements will be repeated. Three sequential failures will cause the system
29 to be removed from service. Any failed component must be replaced/repaired
30 and a new standard response (with a new standard deviation and acceptance
31 range as calculated above) calculated before being redeployed to the field.
32

33 **4.9.1.3 Data Processing.**

34

35 Geophysical data (amplitude and location) will be downloaded periodically to
36 avoid possible data loss or corruption. The geophysical data will be checked,
37 edited for corrections, and processed into ASCII files using the same
38 procedures and routines as used to verify detection performance. The data will
39 be presented in delineated fields as x, y, and z, where x and y are survey lane
40 coordinates in easting and northing, and z is the instrument reading. Where
41 multiple instrument values are recorded, the data will be presented as x, y,
42 $z_1 \dots z_n$ in the same ASCII file. An example file header is presented in Appendix K
43 (MTADS Standard Operating Procedure).
44

45 The field data will be imported into the processing software, demoded (as
46 necessary), and processed. Data will be corrected for navigation errors,
47 instrument bias, and measurement drift. All corrections, edits, filtering, or
48 normalization of the data used to identify potential OE anomaly locations will be
49 fully documented in a data processing log. A grid mesh corresponding to the

survey grid or lane will be generated. This mesh will be the input data for the automatic anomaly discrimination routine used.

Field processing will include a symbol posting of the measurement stations along the survey lanes and generation of simple profiles of the data measured at each of the geophysical receivers of the array. A visual inspection of data will be performed to identify any single-point anomalies, steps in response, or incoherent signal/excessive noise bandwidth. All such events will be noted and described in the field logbooks. This field processing will be performed by the geophysical subcontractor and delivered to the remediation contractor's Project Manager no later than 5 working days after data collection.

4.9.1.4 Anomaly Identification.

Anomaly location is accomplished by identification of discrete response parameters distinct from background response levels. The data processing and QC will be performed using *Geosoft® Oasis montaj* or *Golden Software® SURFER for Windows* software to perform data quality checks, validate data, and make the required plots. The MTADS DAQ software will be used to select suspect anomalies and print out target lists ("dig sheets") in ASCII format for the reacquisition of sampling locations. Turnaround for anomaly identification will be approximately 5 working days from collection date.

Data resolution will be such that anomaly locations can be identified to within a 1.65-foot radius of the source location. Processing of digital data will include a symbol posting of centerline locations of the sensor array and production of color plots of the data mesh over the survey area. Anomaly symbols and identification numbers will be superimposed on these plots. An ASCII-format tabulation of the anomalies will be generated. The table will include anomaly number, northing and easting (in CSP coordinates), anomaly amplitude, and other anomaly attributes (i.e., depth estimate). No differentiation of target characteristics will be accomplished (all identified anomalies will be investigated).

4.9.2 Review of Field Data

Field data will be reviewed daily by the remediation contractor's site geophysicist. To assess usefulness of the data for detecting and resolving OE anomalies, noise levels in the data will be analyzed to ensure that they are sufficiently low to allow adequate signal-to-noise differentiation of pertinent anomalies. Typically, the root mean square background noise response is approximately 5 mV. For example, at a 5-mV background, those coherent anomalous responses greater than or equal to 7.5 mV would be considered as potential anomalies of interest. At a minimum, responses at signal-to-noise (S/N) levels greater than 1.5:1 will be identified for discrimination from the background matrix. Responses with S/N less than 1.5:1 will be individually considered for inclusion in the final target selection. Unusable or incomplete data delivered for any survey lane will be reacquired. Any variations or results not compatible with prior results or expectations will be reviewed with the

geophysicist to determine causative features that may be present. These field contacts will be summarized and included in the weekly QC summary report. Field logbooks will be returned to the field team members prior to commencement of the next work day for continuing documentation of the field effort.

The field review will ensure that precise measurements of the geophysical response were obtained by verifying that instrument performance during standardization fell within the established ± 10 -percent acceptance range (range established for the baseline/standard response to a known target, as discussed in Section 4.9.1.2). Daily standardization field measurements and results are to be completely documented in the field logbooks. The field logbooks will be reviewed to ensure proper implementation of the quality controls. A mean deviation from the standard response will be calculated for each instrument used. This will be reported in a progressively updated table.

The CSP coordinates recorded for each survey parcel (discrete areas comprising adjacent survey lanes or transects) will be compared with a master listing to ensure that the sampling data are accurately located within the study area. The field logs will also be reviewed each day to verify that data were collected following a continuous progression along the survey lanes. If the survey progression was interrupted for a particular segment because of terrain or other considerations, the reviewer will verify that the causes of the deviation and the actual mode of progression are fully described in the field logbook notes.

The landmarks, fiducials, and anomaly locations represented in the processed geophysical data will be compared to geophysically referenced spatial data (GIS base maps). The features of the GIS that are reflected in the geophysical data should be locationally coincident to within 1.65 foot. Any discrepancies in positional or locational accuracy of the data noted during the field review will be described, including steps taken to correct or resolve any such QC issues.

The field review will ensure that the survey lane characterization was complete by verifying that the data volume for each receiver array is comparable (± 1 percent) and that the spatial data density (measurements per unit distance) is representative of the mapping effort described in the field logbook. Field notes will be compared to the downloaded digital file data to assure correspondence between lanes searched and lanes recorded.

The percentage of coverage (by an 18-inch by 12-inch mesh) of each investigated segment will be tabulated. Significant lack of coverage (> 2 percent missed) will be flagged and annotated with the steps (to be) taken to resolve the missed coverage. Unavoidable obstacles will have been mapped on the field sketches and should result in direct correspondence with missing data. Data drop-outs or inexplicable data shortages, if not detected during the field review and scheduled for reacquisition, will be evaluated to identify the root problem and steps needed for resolution.

1 The project GIS will progressively accumulate and incorporate GPS,
2 geophysical, and intrusive investigation results. The GIS will be continually
3 reviewed to provide for continuity between contiguous data blocks.
4

5 A table will be developed and progressively updated that presents pertinent
6 anomaly data (e.g., anomaly identity, amplitude, width, apparent source, depth-
7 to-target). The project and field geophysicists will review the intrusive
8 investigation results to verify that the discovered anomaly sources are
9 representative of the detected response. Any anomalies that are not adequately
10 accounted for by the discovered source will be reinvestigated by the field
11 anomaly reacquisition crews.
12

13 **Data Quality Assurance.** A review and verification of 10 percent of the
14 geophysical data will be performed by a third party and will be accomplished in
15 addition to the 100-percent review of the data to be accomplished by field
16 personnel. Data will be audited by processing discretely bounded survey lane
17 segments using the Geosoft Mapping and Processing System and OE Target
18 Analysis.
19

20 Personnel, processing, and interpretive software will not be replicated. Parallel
21 processing in this fashion should result in identification of similar anomalies. QA
22 processing of digital data will include production of representative profiles. The
23 profile images will be used as a QA tool to compare visually discriminated
24 locations with those anomaly locations identified by the automated (digital)
25 target picking routines used to generate the anomaly "dig" lists. QA will
26 comprise the following activities:
27

- 28 • Review of daily field QA documentation (e.g., maps, field notes)
- 29
- 30 • Review of standardization results (instrument precision)
- 31
- 32 • Derivation of data statistics and measurement coordinates (location
- 33 accuracy)
- 34
- 35 • Posting of data for each segment (survey/coverage completeness)
- 36
- 37 • Generation of contour/image/profile plots (representativeness/
- 38 reasonableness)
- 39
- 40 • Comparison of field anomaly map, digital data image, and OE
- 41 sampling results for each area investigated (representativeness).
42

43 Additionally, inert 37mm projectile rounds will be buried in 25 percent of the
44 100-foot by 100-foot grids prior to the initial geophysical survey of each data
45 block (nominally 100 100-foot by 100-foot grids [see Figure 6-2]). The grids
46 within each sector will be randomly selected using a random number generator.
47 The location of each "seeded" target will also be randomly determined using grid
48 northing and easting with a table of generated random numbers (1-100 for both
49 northings and eastings).

Each inert 37mm projectile round will be buried in a horizontal orientation. The pass/fail criteria for these QC targets will be 100-percent detection of all inert OE “seeds” buried at or shallower than the reliable detection depth (targets must be detected and the position identified as an anomalous location to be excavated during the point clearance).

If mapping and detection fails to correctly discriminate the seeded target in any grid, that grid and the eight grids surrounding it will be resurveyed and the data reprocessed. The data will be analyzed to determine why the target item was missed. The results of this analysis will be used to determine corrective measures, as necessary, to ensure subsurface detection of all MPM OE.

The results of the geophysical survey review will be tracked on a master spreadsheet that will tabulate survey area identification, coordinates, and date surveyed. A weekly QC summary will be prepared and submitted to Granite, USACE, and DTSC.

Digital data will be archived to document the geophysical characterization, including thoroughness of the survey, detection efficiency, and locations of identified anomalies; provide a means of quantifying the confidence that can be applied to the OE cleanup results; and preserve and document the extent, precision, accuracy, and quality of the geophysical characterization. The data will be maintained by the OE contractor at the site for Granite and will be available upon request to DTSC and USACE.

4.10 INTRUSIVE INVESTIGATION

Prior to the start of intrusive activities, the SUXOS and SSO will verify that the area around the operating site is clear of all non-essential personnel and that other UXO supervisors have been notified. MSDs will be established and maintained in the vicinity of the operating site, as specified in Chapter 3.0. A typical MSD and MSA are shown on Figure 3-3. MSDs and VSDs for each sector are shown in Figures 3-8 through 3-17.

Excavation of anomalies will be performed in accordance with the procedures outlined in the following subsections. Subsurface OE and OE scrap will be processed in accordance with the OE process detailed in Figure 4-10. OE located during the subsurface search will be reported to the SUXOS. A description of all OE, OE scrap, and non-OE debris recovered will be recorded digitally utilizing pocket PCs as outlined in Section 4.17.1.3.

OE anomaly excavation crews will intrusively investigate all anomaly locations identified during the geophysical mapping to verify anomaly source, as described in the following procedures (unless removal of surface metallic debris accounts for the geophysical anomaly). These procedures, specifically referred to as point clearance, entail an OE cleanup approach that locates and removes OE items individually. Table 4-4 includes estimates for vehicle hours and the type of equipment required for OE point clearance activities. The sequence of

these activities across the Project Site is shown in the Project Schedule (Appendix A).

Anomaly locations, as identified by the remediation contractor, will be recovered using an RTK GPS capable of submeter accuracy to relocate the coordinates of the center of each identified anomaly. Reacquisition personnel will be escorted by UXO-qualified personnel during this activity. The anomaly reacquisition team will refine the anomaly location using the MPA MTADS and record the peak recovered anomaly value and relative background response in a field logbook.

The location of the recovered anomaly peak will be marked with wood lathes, a plastic pin flag, or a clay pigeon. If the anomaly is not recovered by the reacquisition team, the anomaly coordinate location will be marked for further investigation. The data for the undiscovered anomalies will be reviewed by the project geophysicist and the OE team supervisor(s). If there are no clear surface sources (e.g., terrain, vegetation, cultural clutter), the locations are to be explored intrusively. The minimum excavation will be 36 inches wide and 18 inches deep, unless a representative source is discovered before the excavation reaches these dimensions.

Data describing the anomaly sources discovered during the intrusive investigation process will be recorded and input into the site GIS (database) for consideration in areawide clearance activities. Recorded data will include, where possible, size, estimated weight, orientation, depth bgs, and description of the item excavated.

Field crews will use portable mapping equipment and survey instruments to reacquire (relocate) the anomalies. These reacquisition crews will be onsite for the duration of the geophysical mapping and for 1 week after mapping is complete to finish reacquisition activities.

Based upon the density of the anomalies within the South Valley wetlands, one of two methods may be used to recover, investigate, and remove anomalies.

The first method may require dewatering segments of the wetlands and would be used in areas with high anomaly density. It is anticipated that this method would be required in the east portion of the wetlands adjacent to Demolition Sites #1, #3, and the Flare Site. This would be accomplished through use of temporary dams with the water being pumped around the area to be point cleared. Dewatering will be completed in such a manner so that no heavily silt-laden water flows into the wetlands. Once the anomalies are recovered, the source will be removed, the area will be remapped, and the process repeated until two complete mapping and anomaly removal cycles have been completed. Segments will be established with a minimum of a 10-foot overlap to assist in complete detection and removal of anomalies.

The second method involves use of a rigid, reusable water and sediment barrier that is approximately 8 feet in diameter. The barrier will be placed around the anomaly location, and the inside would be dewatered. This method will be used

in areas with a low density of anomalies; it is anticipated to be used in the west portion of the South Valley wetlands.

4.10.1 Subsurface Ordnance and Explosives Investigation and Clearance (Point Clearance)

Equipment

The equipment requirements for this activity include:

- Instrumentation (hand-held, site-tested metal detectors [e.g., White Pulse Induction SurfMaster, Geonics EM61-HH]) used to assess proximity to subsurface metallic anomalies and/or OE during progress of excavation
- Miscellaneous common hand tools (e.g., screwdrivers, digging implements)
- Forms and logbooks to record activities
- Backhoe, if necessary.

The actual investigative excavation nominally progresses in 6-inch lifts. To assure a margin of safety for the OE teams, the instruments used to assess the proximity of subsurface metallic anomaly sources must be capable of “outreaching” the penetration of the digging implements. Therefore, instrumentation to be used to ensure personnel safety during intrusive operations will be capable of detecting a 37mm HE projectile at 12 inches bgs. Each instrument will be checked daily at a standard location to ensure proper equipment function and operation.

4.10.2 Near-Surface Anomalies

Near-surface anomaly sources are those that are partially exposed or suspected to be within 1 foot of the surface and that can be excavated using hand tools. These anomalies will be excavated by carefully removing the earth overburden using a hand shovel/trowel or other small digging implement. Throughout the excavation, the UXO Technicians will use site-tested detection instrumentation to check and verify the proximity of the anomaly source.

It is anticipated that a limited amount of soil will be removed from the wetlands during the investigation of near-surface anomalies. Because of the regulations of regarding placement of fill in wetlands, no excavated soils will be intentionally placed back in the wetlands. All excavated material from the wetlands will be removed and placed on the Ridge for later placement and scanning in the bottom of the North Valley.

4.10.3 Subsurface Anomalies

Subsurface anomalies are those caused by sources that are more deeply buried (>1-foot bgs). Some of these may require excavation using heavy equipment (e.g., backhoe). For these excavations, an UXO Supervisor will coordinate equipment requirements with the SUXOS. Prior to the arrival of the heavy equipment, the UXO Supervisor will ensure that a cleared entrance and egress path is available for the heavy equipment. Heavy equipment or manual digging tools will be used to excavate the earth overburden in 6-inch lifts. After each lift, the anomaly location will be redefined with a site-tested metal detector and the anomaly source exploratively sought using hand tools. This process will continue until the source of the anomaly has been uncovered and identified.

When a technician is checking backhoe excavations for suspected OE source proximity, the backhoe bucket will be placed on the ground, away from the excavation, and the operator will keep his/her hands clear of the operating controls. The backhoe operator will resume excavation operations only after the UXO Technician is clear of the excavation and outside of the bucket swing area.

It is not anticipated that the use of heavy equipment will be necessary in the South Valley wetlands.

4.10.4 Identification of Non-OE Debris, OE Scrap, OE-like Item, Potential OE, and OE

OE clearance crews will identify recovered anomaly type as non-OE debris, OE scrap, OE-like item, potential OE, or OE. The crews will record anomaly source type, depth, dimensions, and condition on the pocket PC.

An item will be identified as potential OE if it cannot be determined whether explosives are present. Potential OE items will be handled as OE by the OE removal crew, and potential OE and OE items will be left in place and flagged for further inspection by the demolition team. Excavated non-OE, OE-like items, and OE scrap items will be collected and placed in the southwest corner of each grid section that will be laid out on the Project Site.

All non-OE scrap and OE scrap, to include inert OE items, will be inspected by two UXO IIs from the OE clearance crew prior to being placed in the southwest corner of the clearance grid. All non-OE scrap, OE scrap, and inert OE items will be segregated as it is placed in the southwest corner of the grid.

Prior to moving the OE scrap to the central collection area, it will be reinspected by at least two UXO IIs from the demolition team. After completing their inspection, the demolition team will transport the OE scrap directly to the central collection point.

After the OE clearance crew has collected the non-OE debris, OE-like items, and OE scrap items and flagged potential OE and OE items, the demolition team will further inspect all flagged items to make a final determination if an item

1 is OE or OE scrap. OE scrap items will be handled as previously described.
2 The demolition crew will also further inspect the non-OE debris and OE scrap
3 items collected by the OE clearance crew to certify that these items are not OE.
4 Once certified as not OE, the non-OE debris and OE scrap items will be moved
5 to a central on-site location for storage in a locked container to ensure scrap
6 inventory remains segregated from any potential OE (see Figure 4-10).
7

8 **4.10.5 Determination of Safe to Move**

9

10 The demolition team will inspect each OE item to determine if it is safe to move
11 (i.e., the item can be moved with minimal risk). The inspection will be directed
12 by the SUXOS in conjunction with the SSO and USACE Safety Specialist. Their
13 determination will be based on available Ordnance Technical Manual data,
14 training, and professional knowledge, using the following criteria in conjunction
15 with the OE Process Flowchart (see Figure 4-10).
16

17 Each OE item will be inspected to determine if it is armed or unarmed, and if it is
18 unsafe to move due to damage. An item is considered armed if it has been fired
19 or used for its intended purpose. The determination that it is armed or unarmed
20 is in part based on the following criteria:
21

- 22 • Proper identification of ordnance item and fuzing. Utilizing the
23 applicable technical manuals, the item will be identified based on
24 size, shape, and any visible markings. Items unable to be positively
25 identified will not be moved and will be BIP.
26
- 27 • Determination whether item is armed or unarmed. Item will be
28 examined for indications of arming. For example, projectile rotating
29 bands would be scored if fired. Mortars would have an impinged
30 percussion primer.
31
- 32 • Projectiles - Check the rotating band. If it has been scored by the
33 rifling in the gun tube, it has been fired, and if fuzed, it must be
34 considered armed.
35
- 36 • Mortars - Check the ignition cartridge and percussion primer. If the
37 primer is impinged, it must be considered fired, and if fuzed, it must
38 be considered armed.
39
- 40 • Hand Grenades - Check the safety pin and spoon. If the safety pin
41 and/or spoon are missing, it is armed.
42

43 An item, either armed or unarmed, may have been rendered unsafe to move
44 due to damage. Types of damage that may render an item unsafe could
45 include, but are not limited to, the following:
46

- 47 • Dents in the body or fuzing systems.
- 48 • Holes or rips in the body or fuzing systems.
- 49 • Burned. If there is visible scorching and/or soot present.

The results of this determination will be recorded in the SUXOS's field log. Data will include grid identifier and an inventory of the OE (or identifiable OE scrap). OE items that are armed or determined unsafe due to damage, or whose status cannot be safely evaluated due to deterioration or positioning, will not be considered safe to move. OE items that are unarmed and not rendered unsafe due to damage may be considered safe to move. In some cases, OE items that are damaged may be moved if OE Technical Manual data indicate that the items are safe to move.

4.11 ORDNANCE AND EXPLOSIVES DISPOSAL

Items determined to be safe to move will be relocated by the demolition team to one of the two Bureau of Alcohol, Tobacco, and Firearms (BATF) Type II, explosives storage magazines on the Project Site (Figure 4-14). These items will be stored until they are either explosively or mechanically expended. Percussion primers that have not been impinged on cartridge cases and mortar fin assemblies have been otherwise completely expended due to past demolition procedures will be designated as OE. These primers will be mechanically impinged prior to off-site disposal. The duration for which OE items will be stored is dependent upon the accumulated explosive weight of the OE recovered, the explosive weight storage limit of the on-site magazine as established by required permits, and Resource Conservation and Recovery Act (RCRA) storage requirements, which regulate the length of time OE items can be stored.

To ensure that the permitted magazine explosive weight limit is not exceeded, an inventory of all recovered OE items will be maintained on Magazine Data Cards, and a running total of accumulated explosive weights will be maintained. The following procedures will be accomplished to complete the inventory.

- Procedures depicted for entering an "enclosed space" in the OE SSHP will be considered and used as required before entering the magazine.
- Once the space has been entered, a thorough inspection of the magazine contents will be conducted to positively identify any OE or OE-related materials that may be present.
- OE will be disposed of as delineated in the following paragraphs.

4.11.1 Demolition Operations

4.11.1.1 Ordnance and Explosives Demolition Procedures.

UXO personnel will dispose of OE that cannot be moved on a daily basis. Demolition operations will begin at a work site after all nonessential personnel are out of the MSD of the ordnance being detonated. OE that is safe to move

will be consolidated in magazines and will be disposed of at the end of each work week.

At a minimum, the OE disposal operations team will consist of three UXO-qualified individuals, including the SSO, UXO Supervisor, and a UXO Technician.

The SUXOS and SSO will be on site at all times during demolition operations. These operations will be performed under the direction and supervision of the SUXOS, who is charged with the responsibility of ensuring that procedures contained in this OE RDD and referenced documents are followed. The SSO and USACE Safety Specialist will monitor compliance with the safety measures contained in the OE SSHP. In the event of noncompliance, the SSO will stop or suspend operations until the operations are in compliance. Demolition activities are inherently hazardous and require strict adherence to approved safety and operational procedures. Violations of procedures may result in immediate removal of the violating party from this project.

4.11.1.2 *Ordinance and Explosives Disposal Site Control.*

Prior to initiation of demolition operations, all personnel will be withdrawn to a distance outside the MSD of the OE being detonated. Prior to priming of the demolition charges, all avenues of ingress will be physically blocked by UXO personnel. Radio communications will be maintained among all concerned parties. Avenues of ingress will not be opened without the express permission of the SSO. A constant state of vigilance will be maintained by all personnel to detect any intrusion into the MSD.

All demolition operations will be conducted by safely detonating OE items using Standard Operating Procedures for OE Demolition/Disposal Operations (Appendix I) and USACE-approved engineering controls, as specified in HNC-ED-CS-S-98-7, August 1998, to control/minimize hazards of blast and fragmentation (see Appendix J). The SSO will monitor compliance with safety measures contained in the OE SSHP and will stop or suspend operations in the event of noncompliance. In all cases, disposal operations will be performed between the hours of 9:00 a.m. and 3:00 p.m. Monday through Friday, and will not be conducted during days of low cloud cover or temperature inversions, which could amplify noise associated with detonations and adversely affect local residences.

Air monitoring will be performed as specified in Section 3.2.1 at two PM₁₀ monitoring stations downwind and one PM₁₀ monitoring station upwind during all OE detonations.

4.11.1.3 *On-Site Blast Chamber.*

A self-contained blast chamber will be deployed and set up on the Project Site for the disposal of OE items that can be safely moved. The on-site blast chamber will be situated within an area of the Project Site that satisfies the 670-foot RCRA setback requirement (Figure 4-15). If OE items exceed the capacity of the on-site blast chamber, an open detonation will be accomplished

1 in accordance with USACE design criteria(Appendix J) and Section 4.11.1.5 of
2 this OE RDD.

3 4 **4.11.1.4 "Not Safe to Move" OE Items.**

5
6 If an OE item cannot be moved, it will be BIP after authorization has been
7 received to conduct the procedure from DTSC and USACE (Appendix I and
8 Appendix J). BIP operations will be performed under the direction and
9 supervision of the SUXOS. The USACE Safety Specialist will provide safety
10 and QA oversight for all BIP operations.

11
12 To identify if the item to be detonated is in direct contact with a secondary OE
13 item, which could add to the total explosive weight if it should it sympathetically
14 detonated during a BIP operation, the OE item will be investigated using a mine
15 probe. Should the item be found to be in direct contact with another OE item,
16 appropriate engineering controls will be employed to either eliminate the direct
17 item-to-item contact, which will in turn eliminate the possibility of a sympathetic
18 detonation, or to compensate for the potential detonation of the second item
19 during the intentional demolition of the first item.

20
21 Mitigation in the freshwater marsh/riparian areas of the South Valley due to BIP
22 demolition of identified OE will be accomplished through controlling surface
23 water runoff and minimization of sediment transport. Surface water runoff will
24 be controlled as specified in the SWPPP (see Section 3.2.3). Swales, sand bag
25 check dams, or earthen dikes will be used to control or minimize channelized
26 runoff. Sediment transport will be further controlled, if necessary, through use of
27 straw bales, silt fences, or sand bag barriers.

28 29 **4.11.1.5 On-Site Open Blast/Open Detonation.**

30
31 A contingency plan will be implemented for on-site detonation at a constructed
32 demolition site of safe-to-move OE items that are too large to be destroyed in
33 the blast chamber. The designated demolition site will be cleared of any
34 potential OE prior to construction. The open blast/open demolition site would be
35 constructed at the site of the former Howitzer Test Facility (see Figure 4-15).
36 Construction of the demolition site will include a pliable liner under 3 feet of
37 native soil. A berm will be constructed around the area. A hose will be placed
38 at the bottom of the demolition site, leading out of the demolition area, and
39 capped. This hose will be used to pump any water that may collect in the
40 demolition area into 55-gallon drums (Figure 4-16). A cover will be placed over
41 the demolition area to reduce fugitive dust and to prevent rain water from
42 entering the area.

43 44 **4.11.1.6 Demolition Site Testing/Treatment.**

45
46 The open demolition site used for disposal of OE where explosives are used as
47 the disposal method will be tested and treated for toxic substances in
48 accordance with the non-OE RDD. The sites used for BIP demolition of OE will

1 be left unearthed and positively marked for follow-on testing in accordance with
2 the non-OE RDD.

3
4 After the follow-on testing for the BIP sites is completed, the area will be
5 backfilled to match surrounding topography. In the freshwater marsh/riparian
6 areas, seed-impregnated fiber mats will be placed over the disturbed area.
7

8 **4.11.1.7 Ordnance and Explosives Demolition Shots.**

9

10 Prior to priming of demolition shots, the demolition team supervisor will direct all
11 nonessential personnel to withdraw outside the MSD. Upon priming of
12 demolition shots and prior to detonation of demolition shots, all remaining
13 personnel will withdraw outside the MSD.
14

15 Authority to initiate demolition shot setup and detonation will rest solely with the
16 SUXOS. Prior to authorizing the detonation of explosive charges, the SUXOS is
17 responsible for ensuring that all personnel have been evacuated from the MSD,
18 all personnel have been accounted for, all pertinent parties have been notified of
19 an impending demolition shot, and the area is secure. The SUXOS will notify
20 the local fire department of the location and approximate times prior to
21 detonation.
22

23 Upon completion of demolition operations, the demolition team will visually
24 inspect each demolition shot. Upon completion of this inspection, and assuming
25 there are no residual hazards, the SUXOS will authorize the resumption of site
26 operations.
27

28 **4.11.2 Removal and Disposal of Scrap Metal**

29

30 The SUXOS will establish temporary collection points for any OE scrap
31 recovered at each demolition shot location. Only items that are free of
32 explosives but considered OE scrap will be placed into these collection points.
33 The material in these temporary collection points will be transported to the pre-
34 designated central scrap collection point (Figure 4-17). As the material is being
35 loaded, the SUXOS will perform an inspection of the material to ensure that it is
36 free of explosives and other hazardous materials. All inert/empty ordnance
37 items will be vented such that a hole is punched through the items to allow
38 visual inspection of the interior of the item.
39

40 The SUXOS will perform a final inspection of the scrap at the central collection
41 point that was either recovered in the field or collected during demolition
42 operations. The SUXOS will certify the scrap to be free of any explosive hazard.
43 The SUXOS and UXO QC Supervisor will sign and annotate a Release/Receipt
44 Document with the following statement: "I certify that the property listed hereon
45 has been inspected by me and, to the best of my knowledge and belief, contains
46 no items of a dangerous nature."
47

48 The OE scrap collected during field activities will be stored in a lockable storage
49 shelter that will be locked at the close of each business day. Prior to shipment

of metal scrap to a local scrap dealer, the scrap will be visually inspected on all sides (inside and outside) to ensure that no HE or explosive materials are present and, if necessary, that the item will be rendered such as not to resemble an OE item. The scrap will then be picked up and delivered to a local scrap dealer for recycling.

4.12 TNT-AFFECTED SOILS

Earthwork activities addressed in this section include the operations associated with homogenizing, excavating, and stockpiling soil from the TNT Strips with TNT concentrations of 10 percent or more by weight. The sequence of field activities are shown on the Project Schedule (Appendix A).

4.12.1 Site Safety

Due to the explosive potential of soils containing TNT at concentrations of 10 percent or greater, the following protective measures will be employed on the Project Site whenever remediating soil within the TNT Strips:
All work will be conducted in strict accordance with the OE SSHP.

- During the homogenization of TNT-affected soil, all mobile equipment will be rubber tired.
- Equipment utilized during homogenization, excavating, and material handling will have smooth-lipped buckets
- Equipment used to homogenize and excavate explosives-affected soil will have sealed bearings and shielded electrical junction boxes. Equipment will also be decontaminated routinely to prevent the buildup of dust.
- Spray water for dust control and reducing potential for ignition or detonation will be applied at TNT-affected soil handling points. The amount of water applied to soil will be adjusted such that runoff is minimized, equipment can operate efficiently, and maximum content is maintained. The criteria for success of the dust control efforts shall be the absence of visible airborne dust and the confirmation that the quantity of dust at the perimeter of the Project Site is below action levels. Pre-wetting of excavation areas will be of primary concern, followed by additional wetting at other locations, such as the staging area, as required. A full-time water truck will be dedicated to the TNT Strips area.
- All vehicles (trucks) utilized to transport TNT-affected soil will use bottom dump gate tarps or equal, to negate soil spillage.
- Stationary equipment in close contact with TNT-affected soils (e.g., high-pressure steam cleaners, trailers) will be grounded.

- Fuel will be stored outside the MSD. Fuel trucks will not enter the MSD. Fuel will either be provided in OSHA-approved 5-gallon fuel containers or by a hose that will be passed across the MSD boundary to refuel heavy equipment as necessary. During refueling operations, any equipment that will be moved outside the MSD (including fuel containers and fuel hoses) will be decontaminated if it comes in contact with the ground.

4.12.2 Site Preparation.

4.12.2.1 Minimum Separation Distance for Ordnance and Explosives Operations.

The MSD for the TNT Strips is 412 feet (Figure 4-18), measured from the perimeters of the strips.

4.12.2.2 Preparation of the TNT Strips.

The excavation zone will be based upon a review of the existing analytical data from site investigation actions, ground cover, and site topography that indicate the presence of the TNT. The initial excavation zone shall be laid out by land survey techniques using stationing and grid boundaries. In addition, offset stations shall be set for the grid and soil sampling locations in order to be able to accurately re-establish the primary excavation zone and sampling locations for any subsequent lifts of material. Soil sampling location stations shall include grid and side-wall stations as well as locations of previous known areas of elevated surface TNT concentrations. All offsets shall be set in a semipermanent fashion (rebar pins or wooden hubs) and appropriately flagged and protected. Once grid boundary stations have been set, the initial excavation limit shall be indicated for equipment operators through the use of boundary flagging or sprayed chalk lines.

Field personnel will establish equipment entry and exit routes. The final configuration of these routes will include consideration for truck loading operations in order to minimize truck decontamination requirements, for easy access to station offset stakes for recovery of sampling points and grid boundaries, and for dust control needs and water truck access.

Air monitoring will be performed at two PM₁₀ monitoring stations downwind and one PM₁₀ monitoring station upwind of all homogenization and excavation activities as described in Section 3.2.1.

In addition to worker safety requirements dictated by the OE SSHP, the tractor planned to pull the plow and disc implements will have a fully enclosed cab that is air conditioned. The tractor doors and windows will be closed and latched during the homogenization operations. The back window of the tractor or other windows in a direct path of potential soil particles will be equipped with a 4-ply Lexan plate (Underwriters Laboratory listed 752PSA [Level 3]) of an

approximate 1.3-inch thickness. The side and front windows not in a direct path of potential fragments will be equipped with Lexan CTG plate (in accordance with ANSI Z87.1989) of approximate 1/8-inch thickness.

4.12.2.3 Storm Water Control.

As excavation proceeds, conditions will be monitored and runoff (soil mounding and/or interceptor trenches) will be controlled, as necessary. Storm water will be controlled as specified in the SWPPP (see Section 3.2.3).

4.12.3 Methods for Homogenization of TNT-Affected Soils

Some surface soil within the TNT Strips in the top 2-1/2 feet is potentially explosive because it contains 10 percent or more explosives by weight. The methods for homogenizing TNT-affected soil for safe handling are described in the following subsections.

4.12.3.1 Soil Homogenization.

The homogenization process will be accomplished within the portion of each strip devoid of vegetation. The area to be homogenized will be pre-wetted using a water truck.

Homogenization will be a two-step process. If there is no evidence of metallic OE or OE scrap in the TNT Strips and after the strip has been adequately watered, the first step will be for a 2-foot layer to be completely turned using a narrow-width deep plow pulled behind a 4-wheel drive, rubber-tired tractor (if OE/OE scrap are present, the thickness of the first layer will be 6 inches less than the reliable detection depth of the instrumentation used to clear the site). The goal of this plowing step is to bring the soil at the bottom of the layer to the top surface. The total number of passes of this plowing process for any homogenization zone will be dependent on the actual subsurface conditions encountered in the field, but will likely require multiple passes.

Only essential personnel will be inside the MSD during the homogenization operations: the equipment operator in the excavation zone and the air monitoring technician. The equipment operator is necessary to operate the equipment used to homogenize the soil, and the air monitoring person is required to monitor the air quality. The equipment operator and the air monitoring person will wear protective vests and helmets during all homogenization operations. The air monitoring person will be cognizant of the need to operate air monitoring tasks as far from homogenization operations as possible, while successfully completing tasks and while keeping in visual contact with the equipment operator. This visual contact is important as support for the buddy system safety requirement whenever a person is located in the excavation zone.

A water truck and water spray operator will not be within the 412-foot MSD during homogenization operations. Initial wetting operations will occur prior to

the start of homogenization operations, and subsequent wetting will be accomplished to reduce the explosive potential and to ensure suppression of visible dust. Homogenization operations will be suspended during wetting operations. Radio communication will be used for contact between the equipment operator, the water truck operator, and the SUXOS. The SUXOS will oversee the homogenization process and will be available during homogenization activities.

The second homogenization step will utilize a narrow-width farm disc attachment in lieu of the deep plow. The application of the disc attachment will result in de-clumping and full homogenization of the soil layer. Patterns of disc operation will be the same as for the plowing operation, and will be controlled to mix the full homogenization zone.

Soil Sampling during Homogenization

After the two-disc homogenization of the first layer is complete, field screening tests will be performed for the 2-foot soil layer (or a large layer 6 inches less than the reliable depth) at 50-foot intervals along each strip. These field screening tests will be used to evaluate if TNT-affected soil has been adequately homogenized. Two full depth samples (2 feet in depth) will be collected at each test location within 3 feet of each other. The soil sample will be homogenized and composited in the field. A representative sample of the composite sample will be tested. If the field screening tests indicate concentrations of TNT are below the 10-percent threshold, one sample will be collected in the same manner as the field screening sample every 50 feet along each TNT Strip and will be sent for off-site laboratory analysis to verify that final concentrations of total explosives are below the 10-percent threshold. All samples will be homogenized prior to testing. In addition to the above samples, samples will be collected at the former locations where concentrations of TNT exceeded 10 percent.

TNT Strip Confirmation

After the initial homogenization activity is completed and the field and laboratory sampling results are below 10 percent TNT concentration by weight, confirmation samples will be obtained. One confirmation soil sample will be collected from each side wall and one from the bottom of the excavation at each 50-foot interval following excavation of the first lift. In addition, bottom samples will be taken in the location previously identified as having TNT concentrations in excess of 10 percent. These samples will be homogenized and screened for TNT by field screening methods and, if less than the excavation action level for TNT (10 percent by weight), sent off site for explosives analysis using EPA Method 8330. If the TNT concentrations in the side wall confirmation and/or bottom samples are below 10 percent, the homogenization process will be halted. Further excavation will be as described in the non-OE RDD for excavation of TNT soil to below the anticipated post-excavation risk assessment clean up levels.

Confirmation samples will be collected in accordance with methods detailed in the non-OE RDD. The procedures for sample collection are summarized as follows:

- Homogenization confirmation samples will be collected using a hand auger. A 0- to 2-foot sample will be collected for field screening and off-site analysis.
- Excavation side wall and bottom samples will be collected using a long-handled sampler from the top of the excavation.

4.12.3.2 *Soil Excavation and Loading.*

Soil excavation and loading in TNT strip locations will be conducted in a methodical manner to maintain safe conditions and allow the collection of defensible confirmation sampling. Air quality monitoring, as outlined in Section 3.2.1 and the OE SSHP (Appendix F), will be accomplished to verify that health protection action levels for dust are not exceeded.

Excavation will be coordinated based on the availability of the construction personnel (i.e., 8 a.m. to 5:30 p.m.) and soil excavation confirmation sampling turnaround times. Excavation will be considered complete based on field test samples and laboratory analytical results and the absence of TNT soil concentrations exceeding 10 percent. Once TNT concentrations are confirmed to be less than 10 percent, the soil will be characterized for off-site disposal.

The following landfills with the capability to accept soil containing TNT have been identified:

- Kettleman Hills, California (Class I)
- ECDC Facility, East Carbon, Utah (Class I)
- Altamont Pass, Livermore, California (Class II)
- Keller Canyon, Pittsburgh, California (Class II).

Each landfill specifies their own profiling requirements, including the number of samples that need to be collected and the types of analyses that are required. Data collected during the RI/FS will be used for general characterization of the TNT Strip soil. After the homogenization process, all soils to be excavated will be non-reactive (i.e., explosives levels in the soil will be less than 10 percent by weight). The following criteria will be used to determine if the soil will go to a Class I or Class II landfill.

- Does the soil exhibit characteristics of toxicity as specified in 22 California Code of Regulations (CCR) 66261.24 (i.e., acute aquatic 96-hour LC50 less than 500 milligrams per liter).
- Are 2,4-dinitrotoluene (DNT) concentrations greater than 0.13 milligrams per liter using the Toxicity Characteristic Leaching Procedure.

1 If either of the above criteria are exceeded, the soil would be considered a Class
2 I waste and must be disposed of at either Kettleman Hills Landfill or the ECDC
3 facility. The soil would be classified as a Class II waste if it does not exceed the
4 above criteria and, therefore, may be disposed of at a Class II landfill. The
5 sampling protocols specified below have been designed to satisfy the landfill's
6 waste characterization guidelines in order to properly classify TNT Strip spoils
7 following the homogenization process.
8

9 The following considerations will be incorporated into the excavation methods:
10

- 11 • Water spraying will be implemented during excavation, as
12 necessary, to control the presence of visible dust.
13
- 14 • Slopes associated with greater than 5 feet in height excavations are
15 not expected. If slopes are created that are greater than 5 feet in
16 height, they will warrant special excavation safety requirements.
17
- 18 • Soil management options will include placing excavated soil onto a
19 20-mil polyethylene liner adjacent to the excavation or in the bottom
20 of the North Valley, and installing an additional 20-mil (minimum)
21 cover for protection from precipitation and wind or direct loading and
22 shipment to an off-site landfill based on landfill acceptance criteria.
23 If the option to place the soil on a liner adjacent to the excavation or
24 in the bottom of the North Valley is chosen, the soil and the liner will
25 be disposed of at a suitable landfill. The soil beneath the liner will
26 be sampled on a frequency consistent with the side wall sampling
27 frequency associated with the soil from its undisturbed location.
28 Excavated soil will only be temporarily stored on liners until waste
29 characterization requirements are completed.
30
- 31 • Completed excavation areas will be isolated by stake and ribbon
32 boundaries to prevent entry or cross-contamination.
33
- 34 • Site conditions that create excessively dusty conditions (i.e., wind)
35 will be monitored in the field, and appropriate actions will be taken.
36 Actions may include applying additional dust control water or
37 applying a dust suppressing agent.
38

39 **Equipment Decontamination**

40

41 All equipment will be fully decontaminated after the homogenization is
42 completed, as well as if buildups of dust become visible on the equipment
43 surfaces. This intermediate decontamination step will be accomplished
44 primarily through the use of dry removal techniques. These decontamination
45 steps are for equipment change-out or maintenance only, and will be confirmed
46 based on visual absence of soil residue from equipment surfaces.
47

48 The purpose of decontamination procedures during soil sampling is to prevent
49 foreign contamination of samples and cross-contamination between sampling

1 locations. Before use, all sampling equipment will be decontaminated by steam-
2 cleaning, or alternatively by washing with a nonphosphate detergent such as
3 Liquinox® or Alconox™ (or equivalent). Equipment washed with a
4 nonphosphate detergent will be double rinsed using potable water and
5 deionized (or Type II) reagent-grade water. The decontamination procedure for
6 sampling equipment will incorporate a detergent wash, potable water rinse, rinse
7 with pesticide-grade methanol, rinse with deionized water, and a final rinse with
8 Type II reagent-grade water. As an alternative to the use of reagent-grade
9 water, analytical data may be collected to indicate that deionized water to be
10 used for the final rinse is free of the substances of interest for this project above
11 the level of detection for the relevant analyses.

12
13 Sampling equipment that is not readily decontaminated will be discarded after
14 each use. Discarded materials, including decontamination solutions, will be
15 accumulated and stored in appropriate containers pending proper disposal.
16 Decontamination procedures will be performed by all field personnel who have
17 been in contact with contaminated or potentially contaminated materials.
18 Procedures for decontamination of field personnel are presented in Section 10.1
19 of the OE SSHP.

20
21 The decontamination facility for heavy equipment will be situated adjacent to,
22 and just west of, the current position of Stockpile #3 (see Figure 4-18). The
23 decontamination facility will be constructed by first removing all brush and
24 performing a surface clearance of the locations. The facility will be
25 approximately 20 feet wide and 30 feet long. A sandbag berm will be placed at
26 all sides of the location. The sandbags and bottom of the facility will be covered
27 with two layers of high-density polyethylene sheeting (HDPE) or five layers of
28 10-mil polyethylene sheeting. This will form a water and debris containment for
29 decontamination of the heavy equipment. A water pump will be placed into the
30 HDPE containment to transfer decontamination effluent to drums placed outside
31 the facility area.

32
33 The heavy equipment will be driven into the facility. Loose soil and material will
34 be removed with a brush; steam cleaned with high-pressure water or portable
35 high-pressure steam spray. All exposed surfaces will be brushed with soap and
36 water. The final step will be to rinse all surfaces with clean water. Prior to
37 driving the heavy equipment out of the facility, all water and debris will be
38 removed from the facility. As the heavy equipment leaves the facility, a final
39 rinse of the equipment will be performed so that all residual debris is removed
40 from the equipment and is captured within the facility.

41
42 Once the homogenization process is complete, and equipment or materials are
43 ready for release from the Project Site, the final decontamination will be verified
44 through the use of surface wipe sampling utilizing Webster's Reagent (solution
45 of 5-percent potassium hydroxide in ethanol). The reagent becomes pink or red
46 if the surface tested is contaminated with TNT and/or break-down derivatives.
47 Samples will be collected from selected containers of wastewater derived from
48 the decontamination rinsate. If more than one container contains water from the
49 same source, only one of the containers will be sampled. Water samples will be

1 handled and shipped to the analytical laboratory in accordance with the QA
2 Project Plan in the non-OE RDD. Additional sampling and analysis of the water
3 may also be required in order to satisfy the requirements of a licensed disposal
4 facility. If no contaminants are detected in the samples collected from the
5 wastewater containers, the water may be discharged directly to the ground
6 surface, on a portion of the Project Site that is not chemically affected and in a
7 manner to prevent surface ponding and runoff. DTSC will be consulted prior to
8 any such discharge. Water containing chemicals above concentrations found in
9 the site's upgradient monitoring well will be transported by a licensed hazardous
10 waste hauler and disposed of at a licensed disposal facility.

11 12 **4.13 POINT CLEARANCE GRADING**

13 14 **4.13.1 Unit D-1 Fill Areas**

15
16 The Unit D-1 fill area (Sector 2) will be excavated in lifts (6 inches less than the
17 reliable scan depth) and the excavated surface will be scanned. An MSD will be
18 established during excavation and intrusive investigations (Figure 4-19). If
19 anomalies are found, they will be point cleared. This procedure will be repeated
20 until the excavation encounters bedrock or reaches the bottom of the fill. If
21 colluvial and/or alluvial material is encountered below the fill, the colluvial and/or
22 alluvial material will be scanned. If anomalies are found, they will be point
23 cleared. The soil that is removed will be temporarily stockpiled in Sector 10A or
24 10B, and then subsequently placed and scanned in the North Valley as
25 engineered fill. The sequencing of this activity is shown on the Project Schedule
26 (Appendix A).

27 28 **4.13.2 North Valley Fill Areas**

29
30 Pre-existing fill material (Figure 4-20) in the bottom of the North Valley will be
31 excavated to 6 inches less than the reliable scan depth (as determined in
32 Section 4.8). The excavation surface will be scanned using the procedures for
33 real-time surveys (see Section 4.8.2). If anomalies are found, they will be point
34 cleared (see Section 4.10). The areas will again be excavated to 6 inches less
35 than the reliable scan depth. The process of excavation scanning and point
36 clearance will continue until the excavation encounters alluvial/colluvial material
37 or bedrock. The exposed surface will be scanned using the procedures for real-
38 time surveys (see Section 4.8.2). If anomalies are found, they will be point
39 cleared. The sequencing of this activity is shown on the Project Schedule
40 (Appendix A). All fill material will be temporarily stockpiled.

41 42 **4.13.3 Demolition Sites #1 and #3**

43
44 Demolition Sites #1 and #3 will be excavated in lifts 6 inches less than the
45 reliable scan depth, geophysically scanned, and the anomalies will be removed.
46 If the reliable depth of the geophysical instruments is greater than 18 inches, the
47 soil will be removed in 12-inch lifts. An MSD will be established during
48 excavation and intrusive investigations. The excavated soil will be stockpiled
49 and samples will be taken and tested to characterize the stockpiled soil. The

excavation in lifts, scanning, and point clearance will be repeated until native soil or bedrock is encountered (estimated depth of approximately 8 to 12 feet bgs) at Demolition Site #3. The mercury impacted soils around Demolition Site #3, will be excavated in lifts until all impacted soil is removed to below the cleanup goals, and confirmed with appropriate sampling as detailed in the non-OE RDD. All soils with chemical concentrations exceeding cleanup goals will be removed and disposed of off site at a suitable landfill (see non-OE RDD for details regarding the characterization, reuse, and/or off-site disposal of these soils). If the chemical concentrations in the stockpiled soil do not exceed cleanup levels, the soil will be used as fill in the demolition sites. If additional soil is required to backfill the excavation, clean crushed bedrock from the Ridge will be used. The detailed steps to point clear Demolition Sites #1 and #3 and the mercury-impacted soils around Demolition Site #3 are shown in the Project Schedule (Appendix A).

4.13.4 Flare Site

The Flare Site will be excavated in lifts as described in Section 4.13.3, geophysically scanned, and anomalies removed. An MSD will be established during excavation and intrusive investigations. The excavated soil will be stockpiled, and samples will be taken and tested to characterize the stockpiled soil. The excavation in lifts, scanning, and point clearance will be repeated until no further anomalies are found and confirmation sampling and testing confirms that soils with chemical concentrations exceeding cleanup goals are removed. All soils with chemical concentrations exceeding cleanup goals will be removed and disposed of off site at a suitable landfill. Details of the characterization, reuse, and/or off-site disposal of these soils are presented in the non-OE RDD. If the chemical concentrations in the stockpiled soil do not exceed cleanup levels, they will be used as fill in the Flare Site. If additional soil is required to backfill the excavation, clean crushed bedrock from the Ridge will be used. The Project Schedule (Appendix A) shows the sequence of activities to point clear the Flare Site.

4.14 AREAWIDE CLEARANCE GRADING

During areawide clearance, the sitewide grid system will be preserved to assure that the occurrence of OE and OE scrap discovered during areawide clearance is documented.

Areawide clearance will be performed along the south slope of the South Valley, which is within the future residential area of Unit D-1 (Figure 4-19). Approximately 4 feet of alluvial/colluvial material above the bedrock will be removed by excavating the material in lifts no greater than 6 inches less than the clearance depth established for digital geophysical surveys (see Section 4.8). After the first lift is removed, the excavated surface will be scanned using the procedures for real-time surveys (see Section 4.8.2), and any anomalies will be point cleared (see Section 4.10). The excavated soil will be stockpiled in Sector 10B.

1 The area that will be subject to areawide clearance grading on the remainder of
2 the Project Site will be determined by the evaluation of the point clearance data
3 and development of the final site conceptual model. The details of the OE point
4 clearance data evaluation are described in Section 3.4.4.2. Areawide clearance
5 will not begin until the chemically affected soils on the Project Site have been
6 remediated and the post- remediation risk assessment has been approved,
7 except for a narrow strip in Unit D-1 on the south slope of the South Valley.
8 Remediation of the chemically affected soils are fully described in the non-OE
9 RDD. Areawide clearance and preparation of the North Valley will be added to
10 the Project Schedule (Appendix A) when the scope of these activities has been
11 defined.

12
13 Based on the results of the evaluation of the distribution of OE and OE scrap,
14 areawide clearance, if required, will be completed in the bottom of the North
15 Valley. Soil within the grids in the bottom of the North Valley requiring areawide
16 clearance will be excavated in lifts no greater than 6 inches less than the reliable
17 depth established for digital geophysical surveys (see Section 4.8). After the
18 first lift is removed, the excavated surface will be scanned using the procedures
19 for real-time surveys (see Section 4.8.2), and any anomalies will be point
20 cleared (see Section 4.10). The excavated soil will be temporarily stockpiled.
21 This process will be continued until two clear lifts are found.

22
23 Following completion of areawide clearance, if applicable on the bottom of the
24 North Valley, the North Valley will be prepared for acceptance of fill soils. This
25 will require the use of heavy equipment to remove existing compressible alluvial
26 materials from the bottom of the North Valley until competent (not compressible)
27 alluvial material is encountered, if recommended by Granite's geotechnical
28 consultant. These soils will be held in a temporary staging area until fill
29 operations begin in the North Valley.

30
31 Subdrains (subsurface drains designed to remove water that may percolate
32 through the fill) will be placed in the lowest parts of the North Valley, as detailed
33 by an approved grading plan.

34
35 Granite proposes the subdrain be constructed using a blanket drain concept.
36 The blanket drain would be constructed over any reworked fill in the valley and
37 would be constructed of Class 2 permeable material meeting Caltrans Standard
38 Specifications. The blanket drain would be a minimum of 2 feet thick and
39 10 feet wide. The drain would be placed in the bottom of the valley and would
40 have branches that extend up any side canyons and would collect any seeps
41 that are identified prior to or during grading. No pipes would be installed within
42 the Class 2 permeable material.

43
44 The stockpiled fill soils and the compressible alluvial soils held in a temporary
45 staging area will be placed back in the North Valley as engineered fill. If
46 scanning of the soil in lifts was required, the fill soils will be placed in the North
47 Valley and scanned in 8-inch lifts using the procedures for real-time surveys
48 (see Section 4.8.2).
49

1 If OE or OE-like items are located while scanning the 8-inch lifts, the source will
2 be removed. The real-time methods and procedures used to scan the
3 stockpiled fill soils would be reviewed by the Project Manager, SUXOS,
4 geophysicist, and the scanning team leader to identify the root cause(s), such as
5 operator error or equipment limitations (see Figure 3-7).
6

7 Soils temporarily stored in Sectors 7, 10A, and 10B will then be placed in the
8 North Valley. These soils will be scanned in 8-inch lifts as they are being placed
9 following the same real-time anomaly detection and disposal methods described
10 for stockpiled soils in Section 4.4.
11

12 Areawide clearance will then be conducted on the remainder of the area
13 identified for areawide clearance by the final site conceptual model. Soils from
14 the grids requiring areawide clearance will be excavated and placed in the North
15 Valley as engineered fill. Soil will be excavated in lifts no greater than 6 inches
16 less than the clearance depth established for digital geophysical surveys (see
17 Section 4.8). After the first lift is removed, the excavated surface will be
18 scanned using the procedures for real-time surveys (see Section 4.8.2), and any
19 anomalies will be point cleared (see Section 4.10). The excavated soil will be
20 scanned in 8-inch lifts as it is being placed as engineered fill in the North Valley.
21 In order to track where soils are to be removed and placed as fill in the North
22 Valley, the grid system established for the OE point clearance will be preserved.
23 The area to be excavated on a daily basis will be clearly marked. If OE or OE
24 scrap are found under the excavated surface or within the soil as it is placed in
25 the North Valley, each subsequent surface will be scanned, and the soil will be
26 scanned as it is placed in the North Valley. If OE or OE-like items are located
27 while scanning the 8-inch lift, the source will be removed and the real-time
28 methods and procedures used to scan the excavated soil will be reviewed as
29 discussed above. If two clear lifts are found (see Section 3.4.4.2), the remaining
30 soil will be removed by grading and deposited in the North Valley as engineered
31 fill without scanning.
32

33 **4.15 GRADING IN AREAS NOT MEETING AREAWIDE CLEARANCE CRITERIA** 34

35 Depending on the results of the evaluation described in Section 4.14, one
36 outcome may be the identification of grids that are not thought to have contained
37 OE. If any of these grids in future residential areas require grading to create the
38 14 feet of crushed bedrock below final site grade, then this grading work will be
39 accomplished using conventional grading techniques; no scanning is
40 anticipated. OE personnel will be on site during the grading operations to
41 identify any potential OE or OE scrap items observed in fill soils. Grading will be
42 completed by providing a minimum of 14 feet of clean crushed bedrock from the
43 Ridge over all soils in future residential areas of the Project Site. These grading
44 activities will be added to the Project Schedule (Appendix A) after the scope has
45 been fully defined.

4.16 ENVIRONMENTAL RESTORATION

As soon as is feasible, vegetation will be reestablished on all graded sloping areas subject to erosion throughout the Project Site using a hydroseed mix that meets the City of Benicia requirements. Mitigation of the loss of vegetation in the freshwater marsh/riparian areas of the South Valley will be accomplished as described in Sections 4.10 and 4.11.1.

4.17 EXPLOSIVES MATERIALS MANAGEMENT AND HANDLING

The Project Manager has overall responsibility for the management of explosives on site. The Project Manager, in conjunction with the SUXOS, is also responsible for the initial quantity and type of demolition material ordered. The SUXOS will be responsible for all subsequent requisitions for demolition materials.

The explosives will be managed in accordance with the references listed below. Explosives will be delivered by the vendor on an as-needed basis to detonate OE encountered on site. Storage of explosives on site is not anticipated.

The documents listed in Table 4-5 were used in preparing this plan.

4.17.1 License and Permits

The remediation contractor will maintain a valid BATF license/permit and an Explosives Purchase/Receipt Authorization List for the receipt of explosives. These documents will be on file and a copy provided to the explosives supplier prior to the purchase of explosives. A copy of all required licenses/permits and an authorization list for the Project Site will be maintained at the site Command Post (see Appendix H).

At least one UXO Technician on the Project Site will possess a California State Blaster's License.

A county permit to conduct demolition operations will be obtained through the County Fire Department prior to OE demolition operations.

4.17.2 Receipt Procedures

Only those individuals named on an authorization list maintained on site by the OE contractor may sign for explosives received from the explosives vendor. To ensure the quantity delivered is the same as the quantity listed on the delivery documents, two UXO Technicians will inventory the delivery prior to signing for any demolition materials.

Explosives deliveries will be accompanied by the explosive supplier's bill of lading. The initial inventory will include reconciling the document with the actual delivery received. One copy of the bill of lading document will be attached to a copy of the purchase requisition (PR) and the purchase order. One copy of

each of these three documents will be kept on file at the site Command Post, and one complete copy will be forwarded to the remediation contractor's contracting office.

4.17.3 Magazine Siting

There are two approved BATF Type 2 outdoor storage magazines at the Project Site. These will be used by the remediation contractor during this project to store OE items that are found to be safe to move. The remediation contractor will ensure that the proper permitting is maintained throughout the project, and that magazine criteria and quantity distance requirements established in ATF - Explosives Law and Regulations ATF P 5400.7 are maintained. The on-site magazines are barricaded and have a separation distance from each other of more than 200 feet and are over 600 feet from the closest inhabited building, which would allow the storage of 2,500 pounds of explosives in each magazine. The remediation contractor will enforce a limit of not more than 50 pounds per magazine and no more than 100 pounds total explosive Net Explosive Weight (NEW) on site at any given time. The magazines are inside a fenced area and are patrolled by a professional security force 24 hours per day, 7 days per week. An annotated location of both magazines is provided on an explosives siting map (see Figure 4-13).

4.17.3.1 Placard Requirements.

BATF and DOD require that all magazines be appropriately posted for content, hazard class, fire fighting hazard, and an emergency notification list. Magazines will be placarded in accordance with DOD 4145.26M and TM 9-1300-206. This will require a Fire Division Class 1 placard for the recovered OE magazines.

4.17.3.2 Emergency Notification.

An emergency notification list containing the names, telephone numbers, and local addresses of the individuals to be notified in the event of an emergency will be posted on the outside and inside of the magazine door. These individuals will be the same individuals authorized to sign for explosives.

4.17.3.3 Explosive Compatibility.

Explosives compatibility will be maintained in accordance with DOD 4145.26M. Table 4-6 lists the various storage compatibility groups, and Table 4-7 is the compatibility chart. In certain instances, it may be necessary to store incompatible items in the same magazine. If this should occur, the incompatible items will be physically separated by a barricade, such as sandbags, within the magazine. This situation is to be short-term in nature and should be avoided if at all possible.

Magazines will remain locked except when receipts, issues, and inventories are being conducted. The two locks on the magazines will require two different keys. One key will be kept by the SUXOS, and the second key will be kept by a

1 designated Ordnance Accountability Officer (OAO), who will be one of the UXO
2 supervisors on site (a UXO Technician III). This procedure ensures that the
3 magazines cannot be accessed without both keys, and that no one individual
4 can gain access to the magazines.

5 6 **4.17.4 Transportation Requirements**

7
8 Transportation of OE and explosives will be conducted in accordance with the
9 federal Department of Transportation (DOT) requirements in 40 CFR for the
10 transport of hazardous substances and other applicable federal, state, and local
11 regulations. Permits for on-site transportation of explosives/OE are not
12 required.

13
14 Explosives will be transported onto the site as shown in Figure 4-20. Primary
15 access to the site from Interstate 680 will be via West Channel Road.
16 Alternative access to the site from Interstate 680 will be via Lake Herman Road,
17 East Second Street, and Rose Drive to the site access point at McAllister Drive.
18 This route minimizes transport through residential areas. Transportation of
19 explosives and OE on site will meet the following criteria:

- 20
21 • Vehicles will be inspected using Weekly Vehicle Inspection
22 checklists and will be properly placarded.
- 23
24 • Explosives will be transported in closed vehicles whenever possible.
25 When an open vehicle is used, explosives will be covered with a
26 flame-resistant tarpaulin (except when loading/unloading).
- 27
28 • Vehicle engine will not be running and wheel chocks and brakes will
29 be set when loading/unloading explosives.
- 30
31 • Beds of vehicles will have either a plastic bed liner, dunnage, or
32 sand bags to protect the explosives from contact with the metal bed
33 and fittings.
- 34
35 • Vehicles transporting explosives will have a first aid kit, two
36 10-pound-rated fire extinguishers, and communications capabilities.
- 37
38 • Initiating explosives, such as detonators, will remain separated at all
39 times.
- 40
41 • Compatibility requirements will be observed.
- 42
43 • Operators transporting explosives will have a valid driver's license.
- 44
45 • Drivers will comply with posted speed limits, but will not exceed a
46 safe and reasonable speed for conditions. Vehicles transporting
47 explosives off-road will not exceed 25 mph.
- 48

49 **4.17.5 Explosives Management Audit Criteria**

Explosives will be delivered to the site by the vendor on a per shot basis; explosives for demolition activities will not be stored on-site. The following items related to explosives acquisition, accountability, and transport will be audited to ensure compliance with this OE RDD:

- The Demolition Shot Record
- The Site Daily Operational and Safety Logs
- The OE Operations Daily/Weekly Report
- The Safety Training Attendance Forms for the initial site hazard training
- The Safety Training Attendance Forms for the Daily Tailgate Safety Briefings
- Magazine inspection records
- The Daily Safety Inspection and Audit Log.

4.18 DATA MANAGEMENT

The responsibility for data and records management and the details of the procedures and requirements for organizing, filing, storing, collecting, and controlling remediation data and records are presented below. The types of data and records included in this plan include:

- Field documentation
- Geophysical data
- GIS data
- Population database.

4.18.1 Field Documentation

Field documentation comprises a permanent record of the field activities associated with the site investigation. All activities at the site will be recorded in the site project logbook. Field logbooks will be used to record specific information and activities related to collection, reduction, and/or interpretation of data in the field.

The following guidelines will be used to maintain field documentation:

- Entries will be completed in permanent black or dark blue ink.
- All entries will be legible.

- Corrections will be made by crossing out the entry to be revised with a single line, initialing, and dating the change.
- Serialized documents or data files will be preserved and maintained on site and referenced in the logbooks, as needed.
- Portions of any page that are not completely filled will have a single diagonal line drawn through the unused portion of the page. The individual lining out the unused portion of the page will sign and date the line.
- The field team leader will sign and date each page of daily entries to the field logbooks.
- The logbooks will be periodically reviewed by the Project Manager (or designee) to ensure that the field effort is being properly and completely documented. This individual will sign and date the bottom of each page to signify his/her review and acceptance.

4.18.1.1 Project Logbooks.

The project logbook is the master field investigation document. Its primary purpose is to preserve, within one document, the actual field data or references to other field documents that contain a specific description of every activity and/or event that has occurred in the field on a given day. The project logbook will also contain administrative occurrences, conditions, or activities that have affected the fieldwork for any given day or task.

4.18.1.2 Field Logbooks.

Field personnel will use bound field logbooks with sequentially numbered pages for maintenance of field records. The front cover of the logbook will list project name, project task, book number, and start/end dates. The inside cover will replicate these data, in addition to listing the personnel performing the fieldwork, with their assigned responsibilities. Each field investigation team will possess and maintain a field logbook series. These logbooks will be used to record the specific field information collected during the progress of the field investigation.

At a minimum, the following information will be recorded each day in the field logbook:

- Name and affiliation of the personnel performing work
- Date, start time, and signature of the individual providing entry
- Significant weather conditions (i.e., conditions that could affect the interpretation of the collected data, or that could affect the progress of work

- Notes of conversations with visitors to the work sites
- Identification numbers of instruments used
- Results of equipment standardization measurements
- Documentation of investigative activities, any abnormal procedures used, digital file names, and narrative morphological description of each area investigated
- Summary of field activities, events affecting the progress of the work, and results for each area (e.g., number of anomalies, any noted anomaly trends, OE identification).

4.18.1.3 Digital Field Data.

In addition to logbooks, field crews will utilize pocket personal computers to electronically collect information during anomaly reacquisition and investigation. Collection of data in this manner will help to ensure proper content and formatting while decreasing the potential for errors during the transfer of data to the database. This electronically collected information will include, but is not limited to:

- Verification of anomaly reacquisition
- Size (in millivolts) of reacquired anomaly
- Source of anomaly (e.g., non-OE, OE scrap)
- Depth and orientation (in eight cardinal directions)
- Location, evidence of demolition, and whether the area is disturbed
- Description of anomaly source including size, weight, and composition.

Anomaly reacquisition and dig list will be distributed to the field teams on the pocket computers. At the end of each day, the work completed and the data collected will be downloaded to a temporary database file and printed. The field team leader will verify accuracy and completeness of the information and sign the printed copy. These copies will be maintained on site for reference and QC purposes. After the electronically collected field data have been checked for completeness and accuracy, they will be appended to a master database.

4.18.2 Geophysical Data

During the OE remediation process, different types of geophysical information will be collected. These include:

- Geophysical data
- Anomaly picks
- Data processing log.

All geophysical data will be delivered in a processed ASCII file format whose file name contains the date and area surveyed. The files will contain delineated fields that correspond to the easting, northing, and instrument reading. They will be maintained in folders named for the area surveyed.

The anomaly picks will be delivered in a comma delineated format. These files will contain anomaly identification, location, size, and expected depth. The anomaly pick files will be named based on the area and date surveyed and maintained in folders named for the area surveyed.

The field processing logs will be named based on the area and date surveyed. They will be Word Perfect files that contain all corrections, edits, filtering, or normalization of the data. They will also be maintained in folders named for the area surveyed.

4.18.3 Geographic Information System

The GIS will use ArcInfo® to monitor the remediation efforts. The GIS will be used to review the geophysical data, plot OE information, and track progress of the field efforts. Each project file will have metadata (name of project file, location, data created, author, content of project, and client). All files will be archived to a CD weekly to prevent any loss of data.

4.18.4 Population Database

A database containing the names of local residents and businesses will be provided to the remediation contractor. This database will be maintained by the provider. It will be delivered in or converted to Microsoft Access format and used for public withdrawal notification.

Table 4-1. Field OE Personnel Workforce

Task	Number of Crews	Number of Persons per Crew	Estimated Production Rate
Vegetation Removal (Manual)	1	7	2 acres/day
Vegetation Removal by Tractor	1	2	8 acres/day
Remove/dispose of construction debris		3	500 tons/day
Installation of Grid Markers	2	2	125 grids/day
OE Surface Clearance	2	5	50 grids/day
Geophysical Mapping (MTADS)	1	3	6 acres/day
Geophysical Mapping (MPA MTADS)	4	2	4 acres/day
Anomaly Reacquisition	2	2	640 numbers/day
Anomaly Excavation	6	7	720 numbers/day
Point Clearance	1	7	1,200 SF/day
Areawide Clearance/Grading	1	4	250 cy/day
OE Scanning of soils placed in North Valley	4	4	2,000 cy/day
Disposal Operations	1	4	2

cy = cubic yard
 MPA = Man-portable Array
 MTADS = Multisensor Towed Array Detection System
 sf = square foot

Table 4-2. Target Locations

Page 1 of 2

Easting	Northing	Object	Depth in Inches ^(a)	Orientation
6520023	1792927	Grid corner		
6520273	1792927	Grid corner		
6520023	1793277	Grid corner		
6520273	1793277	Grid corner		
6520048	1793002	Test Grid		
6520248	1793002	Test Grid		
6520048	1793202	Test Grid		
6520248	1793202	Test Grid		
6520215	1793020	60 mm	12	Vertical
6520221	1793051	60 mm	12	Parallel
6520188	1793042	60 mm	18	Vertical
6520148	1793025.5	60 mm	18	Parallel
6520132	1793084	60 mm	18	Horizontal
6520169	1793089	60 mm	24	Vertical
6520215	1793092	60 mm	24	Parallel
6520230	1793137	60 mm	24	Horizontal
6520219	1793168	60 mm	30	Vertical
6520186	1793182	60 mm	30	Parallel
6520152	1793176	60 mm	30	Horizontal
6520096	1793168	60 mm	24	Vertical
6520064	1793184	60 mm	24	Parallel
6520068	1793148	60 mm	24	Horizontal
6520088	1793125	60 mm	36	Vertical
6520120	1793187	60 mm	36	Parallel
6520239	1793030	37 mm	6	Vertical
6520134	1793051	37 mm	6	Parallel
6520193	1793076	37 mm	12	Vertical
6520235	1793189	37 mm	12	Parallel
6520118	1793025	37 mm	12	Horizontal
6520178	1793017	37 mm	18	Vertical
6520059	1793124	37 mm	18	Parallel
6520081	1793096	37 mm	18	Horizontal
6520107	1793095	37 mm	18	Vertical
6520091	1793078	37 mm	18	Parallel
6520079	1793061	37 mm	18	Horizontal
6520103	1793060	37 mm	24	Horizontal
6520097	1793037	37 mm	24	Parallel
6520083	1793015	37 mm	24	Vertical
6520058	1793013	37 mm	30	Vertical
6520065	1793037	37 mm	30	Parallel

Table 4-2. Target Locations**Page 2 of 2**

Easting	Northing	Object	Depth in Inches ^(a)	Orientation
6520154	1793064	Scrap	15	Flat lying
6520229	1793075	Scrap	15	Flat lying
6520236	1793096	Scrap	15	Flat lying
6520235	1793113	Scrap	3	Flat lying
6520220	1793117	Scrap	3	Flat lying
6520241	1793162	Scrap	3	Flat lying
6520208	1793188	Scrap	6	Flat lying
6520165	1793194	Scrap	6	Flat lying
6520142	1793194	Scrap	6	Flat lying
6520129	1793166	Scrap	9	Flat lying
6520053	1793165	Scrap	9	Flat lying
6520056	1793103	Scrap	9	Flat lying
6520064	1793091	Scrap	12	Flat lying
6520062	1793070	Scrap	12	Flat lying
6520220	1793194	Scrap	12	Flat lying

Note: Depth in inches is based on the calculated maximum depth of detection for EM systems given by:

$$\text{Log}(d) = 1.002 \times \log(\text{dia}) - 1.961$$

Where d = depth to top of target in meters

dia = diameter of the minor axis of target in millimeters

Table 4-3. Geophysical Instrument Applications

Activity	Vehicle-Towed MTADS EM	Digital MPA MTADS EM	Realtime MPA MTADS EM	Hand-held All Metals Detectors
Geophysical Equipment Tests	X	X	X	X
Unit D-1 Fill			X	
Unit D-1 and North Valley Stockpiles			X	
Ridge Stockpiles	X	X		
Geophysical Detection and Mapping for Point Clearance Activities	X	X		
Geophysical QC Surveys	X	X		
Anomaly Location Reacquisition			X	
Areawide Clearance Geophysical Scanning			X	
Safety Instrumentation for Grid Placement and Intrusive Investigations				X

Table 4-4. Estimated Equipment Hours for Intrusive Investigation

Type of Equipment	Quantity	Operation Hours/Day	Number of Work Days	Total Equipment Hours
Tractor	1	8	60	600
D-4 Dozer	1	8	15	150
Excavator	1	8	132	1,320

Table 4-5. Explosives Regulatory References

OSHA General Industry Standards, 29 CFR 1910
OSHA Construction Standards, 29 CFR 1926
CEHNC Safety Concepts and Basic Considerations for Unexploded Ordnance
USACE EM 385-1-1, Safety and Health Requirements Manual
DOD 4145.26-M, Contractor's Safety Manual for Ammunition and Explosives
DOD 4160.21-M, Defense Reutilization and Marketing Manual
DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards
AR 385-64, Ammunition and Explosive Safety
AR 385-10, Army Safety Program
DA PAM 385-64, Ammunition and Explosives Safety Standards
TM 9-1300-206, Ammunition and Explosive Standards
TM 9-1300-200, Ammunition General
TM 9-1300-214, Military Explosives
TM 60A-1-1-31, EOD Disposal Procedures
AR 190-11, Physical Security of Arms, Ammunition and Explosives
ATF 5400.7, Alcohol Tobacco and Firearms Explosives Laws and Regulations
Applicable sections of DOT, 49 CFR 100 to 199

Table 4-6. Storage Compatibility Groups for Explosives and Ammunition
Page 1 of 4

<u>Group A</u>	
Cyclonite (RDX), dry	Mercury fulminate, wet
HMX, dry	PETN, dry
Lead azide, wet	RDX (cyclonite), dry
Lead styphnate, wet	Tetracene, wet
<u>Group B</u>	
Fuses (except chemically actuated fuses containing ampules that may initiate, directly or indirectly, explosives and explosives-loaded components that are conventionally assembled to form the finished explosive fuse).	Detonators
	Mines, practice, AP, M17
	Percussion elements
	Primer detonators
<u>Group C</u>	
Ammunition, blank and saluting, cannon	Cartridge, 90mm, canister, AP
Ammunition, .50 caliber, except API/incendiary	Cartridges, practice, over 40mm
Ammunition, 20mm, practice and high-pressure test	Catapults, aircraft ejection seat, M3A1, M4A1, M5
Ammunition, 25mm, with inert projectile	Charge, propelling, not assembled to projectiles
	EC powder
Ammunition, 27mm, caseless	Detonating cord (primacord)
Ammunition, 30mm, ball and high pressure test	Nitrocellulose
Ammunition, 30mm, practice and training	Fuel (solid), emergency power unit
Ammunition, 37mm and 40mm, TP and AP	Propellant
Ammunition, 40mm, practice, M407A1, M382, and M385	Rockets, practice, 3.5-inch
Benite	Rocket motors, M3, M5, M6, M10, M13, M26, M30, M37, M42, M53, M66; Pershing 1st and 2nd stages; Spartan 1st, 2nd, and 3rd stages
Baron potassium nitrate	
<u>Group D</u>	
Adapter booster	Explosive D
Ammonium nitrate, except in original shipping container or equivalent	Explosives, cratering
Ammonium perchlorate, except when particle size is greater than 15 microns and in original shipping container or equivalent	Grenades, rifle, AT (except pentolite loaded)
Ammonium picrate (Explosive D)	HMX, wet
Bangalore torpedoes	Mine, APERS, MN, M14 (w/integral fuse)
Baratol	Mines, antipersonnel (bounding type)

Table 4-6. Storage Compatibility Groups for Explosives and Ammunition
Page 2 of 4

Black powder, bulk	Mines, antipersonnel (cast iron block)
Bombs, demolition	Mines, HEAT Nitrocellulose wet 8-30% water exposed to detonation hazards at less than intra-line distance
Bombs, fragmentation	Nitroguanidine
Bombs, general purpose	Nitrostarch Octol
Boosters	PBX
Boosters, auxiliary	pentolite
Bursters	PETN, wet
Charge, demolition, snake	Picratol
Charge, springing earth rod, blast driven	Picric acid
Charge, supplementary, HE	Projectiles, HE, fuzed or unfused
Compositions A, A-2, A-3, A-4, B, B-3, C, C-2, C-3, and C-4	RDX (Cyclonite), wet
Cutter, cable M1	Rocket heads, HE and HEAT (except pentolite loaded) w/o motors
Cyclonite (RDX), wet	Shaped charges
Cyclotol	Tetranitrocarbazole (TNC)
Demolition Blocks	Tetryl
Destructor, HE, M10	Tetrytol
Detonating cord (primacord) exposed to detonation hazard at less than intra line distance	TNT
Dynamite	Tritonal
Ednatol	Torpex
<u>Group E</u>	
Ammunition, HEP	Ammunition, fixed and semifixed, 90mm through 106mm, loaded with ammonal, amatol, Explosive D, composition B or TNT
Ammunition, 20mm, HE, HEI and functional packs containing HE and HEI	Cartridge, heavy mortar, over 81mm (including 81mm M56), except chemical loaded
Ammunition, 30mm, HEDP	Cartridge, light mortar, 81mm or less (excluding 81mm M56), except chemical loaded
Ammunition, 37mm, HE	Redeye guided missiles, packaged 3 complete rounds w/launcher
Ammunition, 40mm, HE, RDX loaded	

Table 4-6. Storage Compatibility Groups for Explosives and Ammunition
Page 3 of 4

Ammunition, 40mm, HE, M406, M386, M441, and M463	Rockets, HEAT, 3.5-inch, complete round
Ammunition, 57mm through 81mm, except WP smoke, HEP, and blank	Rockets, HE, 2.75-inch (in LAU-3/A rocket launcher)
<u>Group F</u>	
Grenades, hand offensive	Grenades, fragmentation
<u>Group G</u>	
Ammunition, .50 caliber API and incendiary	Grenades, hand, CN1, ABC, M25A1, w/fuse C12
Ammunition, 20mm, API	Grenades, hand, CM1, ABC, M25A2, w/fuse C12
Ammunition, 20mm, incendiary and functional packs containing incendiary, except those containing HE or HEI	Grenades, illuminating and incendiary
Ammunition, 40mm, riot control and pyrotechnic loaded, except WP smoke	Grenades, practice, w/spotting charge
Bombs, photoflash	Grenades, rifle, smoke, XM48E1 and M22 and M23
Cartridge, igniter, M2	Grenades, smoke (except WP and PWP)
Cartridge, illuminating	Grenades, riot control, CS1, M25A2
Cartridge, photoflash	Igniter, spotting charge
Cartridge cases, primer (w/o propellant)	Igniters for rocket motors (e.g., M12, M18, M20 and M29)
Charge, igniter assembly, for practice hand grenades	Ignition cartridge for trench mortar ammunition
Charge, spotting, APR practice, M8	Illuminating compositions (consolidated in final press operations)
Chemical ammunition, Group B, tear or smoke producing, w/explosive components, over 40mm	Mines, practice, w/spotting charge and/or fuse
Chemical ammunition, Group B, tear or smoke producing, w/o explosive components	Nuclear fire marker device 11-F2
Chemical ammunition, Group D, containing flammable solids, except for TEA or TPA, w/o explosive components	Photoflash powder
Chemical ammunition, Group D, fixed or semi-fixed rounds, containing flammable solids, except for TEA or TPA	Primers, artillery and cannon, percussion and electric
Clusters, incendiary bomb, M31 and M32 (w/o fuzing components)	Projectiles, illuminating
Destroyer, file, M4	Rocket, riot agent, CS, 2.75-inch FFAR, MX99
Detonation, simulator, explosive M80	Simulators, M110, M115, M116, M117, M118, M119 and XM142

Table 4-6. Storage Compatibility Groups for Explosives and Ammunition
Page 4 of 4

Grenade, hand, smoke, HC, M8	Smoke pots
Grenades, hand, CN, M7A1, w/fuse M201A1	Spotting charges (cartridge for miniature practice bombs)
Grenades, hand, CS, M7A3, w/fuse M210A1	
<u>Group H</u>	
Chemical ammunition, Group C	Grenade rifle, WP, M19
Grenades, WP	
<u>Group J</u>	
Chemical ammunition, Group D, containing flammable liquids or gels, with or w/o explosive components	Chemical ammunition, Group D, fixed and semifixed rounds, containing flammable liquids or gels with or without explosive components
<u>Group K</u>	
Chemical ammunition, Group A, with or without explosive components	Chemical ammunition, Group B, with or without explosive components, designed for toxic or incapacitating effects greater than lachrymation
Rockets, toxic chemical agents, complete rounds	
<u>Group L</u>	
Aluminum powder	Fuzes, chemically actuated, containing ampoules which may initiate directly or indirectly, explosives and explosives loaded components which are assembled in the conventional manner to form the finished explosive fuse
Ammonium nitrate	
Ammonium perchlorate	Magnesium powder
Ammunition, pentolite loaded	Grenades, rifle, AT (pentolite loaded)
Chemical Ammunition, Group A, without explosive components	Nitrates (inorganic), except ammonium nitrate (in original shipping container or equivalent)
Chemical ammunition, Group B, without explosive components, designed for toxic or incapacitating effects more severe than lachrymation	Perchlorates
Chemical ammunition, Group D, TEA or TPA components	Peroxides, solid
Chlorates	Rocket heads, pentolite loaded, w/o motors
DNT	Zirconium (types I and II, spec. FED 1665)
<u>Group S</u>	
Ammunition, 40mm, canister and multiple projectile	Fuse lighters
Ammunition, small arms, less than .50 caliber	Fuse safety
Explosive bellows	Squibs commercial
Firing devices	

Table 4-7. Storage Compatibility Chart

Groups	A	B	C	D	E	F	G	H	J	K	L	S
A	X	Z										Z
B	Z	X										X
C			X	Z	Z		Z					X
D			Z	X	X							X
E			Z	X	X							X
F						X						X
G			Z				X					X
H								X				X
J									X			X
K										X	U	
L										U		
S	Z	X	X	X	X	X	X	X	X			X

Note: "X" indicates that these groups may be combined in storage. Otherwise, mixing is either prohibited or restricted per the following statement: "Z" indicates that, when warranted by operational considerations or magazine nonavailability, and when safety is not sacrificed, these groups may be combined in storage. Equal numbers of separately packaged components of complete rounds of any single type of ammunition may be stored together. When so stored, compatibility is that of the assembled rounds (i.e., WP Filler in Group H, HE Filler in Groups D, E, or F, as appropriate). Group K required not only separate storage from other groups, but also requires that munitions having different toxic chemical agent fillers be stored separately from each other. "U" indicates that leaking toxic chemical munitions of one agent type (i.e., GB, with or without explosive components) may be stored together in one magazine specifically designated for storage of leakers of that agent type. Ammunition designated "PRACTICE" by NSN and nomenclature may be stored with the fully loaded ammunition it simulates.